AMERICAN MACHINIST

A JOURNAL FOR MACHINISTS, ENGINEERS, FOUNDERS, BOILER MAKERS, PATTERN MAKERS AND BLACKSMITHS.

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Automatic Tank Punching and Shearing Machine—Triple Head Frame Slotter.

We present on this and the succeeding page illustrations of some recently designed tools by Bement Miles & Co., Philadelphia, Pa. The first of these is a machine for automatically punching the rivet holes and shearing the edges of steel or iron sheets for tanks or similar work, its capacity being to punch a $\frac{5}{8}$″ hole in $\frac{3}{8}$″ steel, shearing and beveling the edge at the same time, and automatically spacing the holes at any required distance up to 2″ by sixteenths of inch. The angle of the bevel is 70 degrees, *i. e.*, the shear is inclined 20 degrees from the vertical, and a side shear cuts the scrap into short pieces.

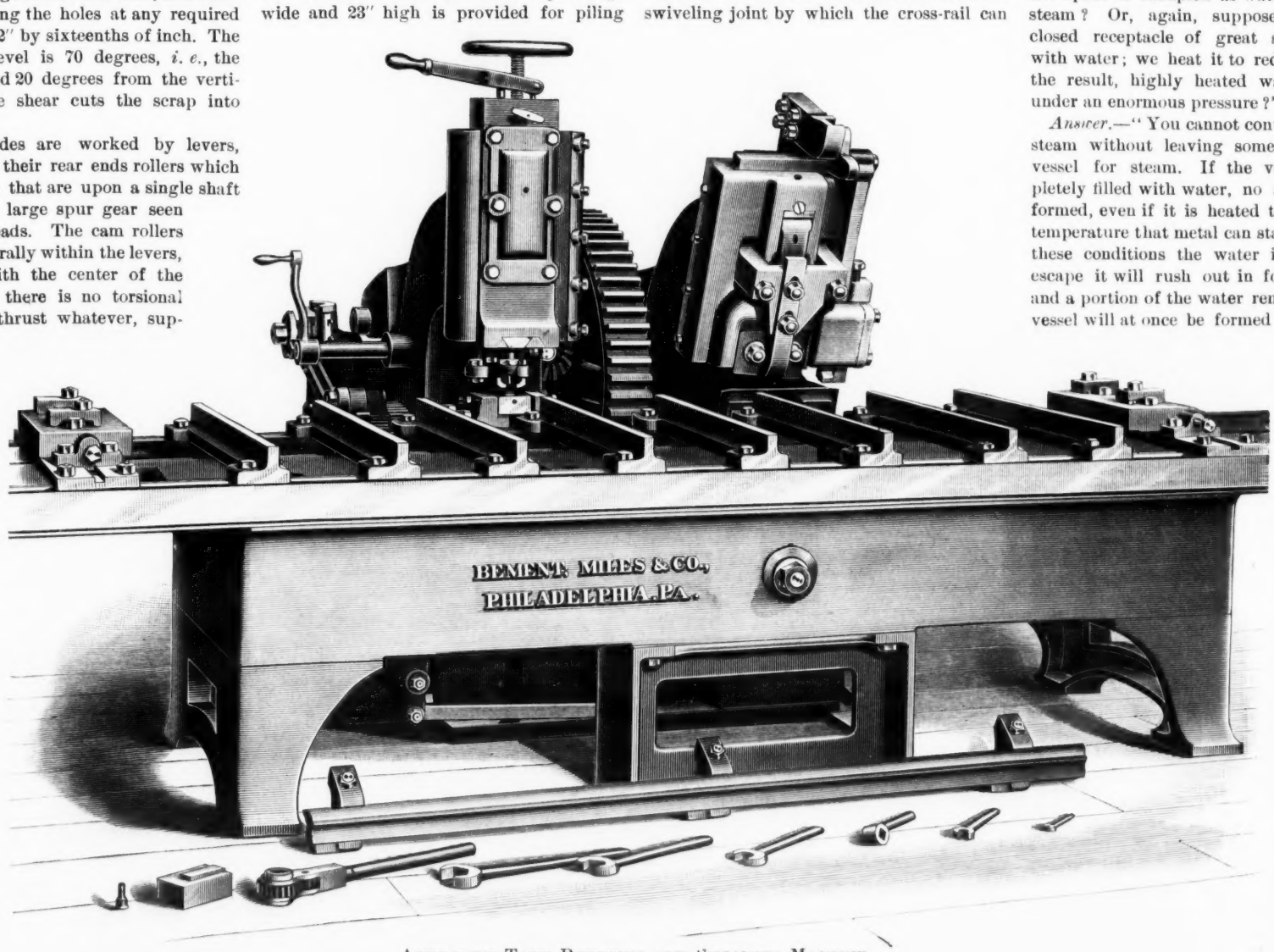
Both the slides are worked by levers, which carry at their rear ends rollers which rest upon cams that are upon a single shaft driven by the large spur gear seen between the heads. The cam rollers are placed centrally within the levers, and in line with the center of the slides, so that there is no torsional strain or side thrust whatever, supplementary return cams being used for the lighter duty of raising the heads.

A crank and lever attached to the cam shaft give the motion for the spacing, which is done by a ratchet and pawl, the latter being automatically lifted at the return stroke to avoid all liability of any return motion of the wheel. From this ratchet a worm is driven which gives motion to the cross-shaft passing under the platen, this shaft carrying a double pinion which can be adjusted to take up all lost motion.

By loosening the hand-wheel and moving the lever at the top of the punch slide, the punch may be brought down to the work to test its setting at starting, a supplementary slide being provided for this. The hand-crank at the left of this head operates a clutch, by which the motion of the heads is controlled. It is not connected directly to the clutch, however, but moves a cam which, in turn, controls the clutch, always releasing it when the slides are at the upper end of the stroke.

Convenient facilities are supplied for fastening sheets to the platen, and the device shown on the floor in front of the machine is for holding angle-irons to be similarly operated upon. The shear can be thrown out of action when desired. There is a rapid traversing motion to the table which is driven separately from the countershaft. The machine can, of course, be built to suit any requirements, but is usually made with bed 43 feet long and platen 25 feet to accommodate sheets 22 feet long.

The second machine is for finishing locomotive frames. It consists essentially of a bed 36 feet long, on which the frames are placed, three sliding heads being gibbed to this bed at either side, so that a space 34¾″ wide and 23″ high is provided for piling frames, the stroke of the rams being 21″, or sufficient for five 4″ frames.



AUTOMATIC TANK PUNCHING AND SHEARING MACHINE.

Each head is virtually a crank shaper, with the saddle so placed on the cross-rail as to give the ram a vertical stroke, the usual Whitworth quick-return motion being provided, and also the usual facilities for changing stroke and vertical position of ram, which is counterbalanced by the lever and weight seen at the top.

Running along the side of the bed at the rear is a splined shaft driven by the pulleys at the left, motion being taken from this shaft for each head by means of bevel gears which drive vertical shafts, these in turn driving the horizontal splined shafts, which, by means of pinions, give motion to the large crank gears, and also to the gears to which are attached the feed cams. These cams are adjustably attached to the gears, and by means of the circular slots and binding bolts seen, can be changed to make the feed take place at the top of the stroke when the pawls are reversed to change the direction of feeding. The cams give motion to the slotted levers seen above them, two feed rods being attached to these, one for giving motion to the saddles on the cross-rail, and the other to the head along the bed, the mechanism for this being readily understandable from the engraving, as is also that for the rapid traverse of the heads along the bed from the splined shaft in front.

Just below the cross-rail in each head is a swiveling joint by which the cross-rail can be placed at the proper angle for the tapering side of the pedestal jaw. Two speeds are provided, one giving eight and the other eleven and a half strokes per minute. The length of bearing of the heads upon the bed is about six feet, and the proportions of the parts, driving power, range of feeds, etc., are such as to adapt it specially to the heavy work for which it is intended.

Mr. L. C. Sharp, who will be recognized as a frequent contributor to our columns, has become interested as a partner in the Omaha (Neb.) Electrical Manufacturing Co., which manufactures and deals in electrical machinery and supplies of all kinds.

The cruiser Neuve de Julio, from the Argentine Republic, now here for the naval review, is said to make 23½ knots with comparative ease. She has triple-expansion engines of 14,500 horse-power.

The Behavior of Liquids at High Temperatures.

BY PROFESSOR JOSEPH TORREY.

In the AMERICAN MACHINIST for February 23, 1893, there appeared among the Questions and Answers the following:

"Can water be vaporized without allowing room for expansion; or could steam, if kept at a high temperature, be reduced to the space it occupied as water, and still be steam? Or, again, suppose we have a closed receptacle of great strength filled with water; we heat it to redness; what is the result, highly heated water or steam under an enormous pressure?"

Answer.—"You cannot convert water into steam without leaving some room in the vessel for steam. If the vessel is completely filled with water, no steam will be formed, even if it is heated to the highest temperature that metal can stand. If under these conditions the water is allowed to escape it will rush out in form of steam, and a portion of the water remaining in the vessel will at once be formed into steam of a definite pressure, depending on the temperature."

This question at once attracted my attention, partly on account of its difficulty and partly on account of recollections it called up. In thinking over the subject by myself, and passing in review the observations and experiences which I could bring to bear on it, the thought occurred to me that perhaps a little more extended study of the question than the question column would allow might interest some readers of the AMERICAN MACHINIST. I was in doubt at first as to the shape in which to present it, but have finally concluded to give full swing to a conviction to which long acquaintance with the AMERICAN MACHINIST has led me, namely, that its readers are always interested in matters purely scientific, as well as in more practical ones. So while the question of the correspondent has no practical bearing whatever, it happens to be one which opens up a view of some of the most beautiful and remarkable results of our modern physical research. Therefore, I have taken some little pains to collect together such facts and literature as are available, giving pretty full references, so that any who have access, as many have, to libraries, can look up the matter more fully, if they wish to do so.

In the *Annales de Chimie et de Physique*, second series, Vol. XXI, page 127, will be found an account of a memorable investigation on the action of heat and pressure on certain liquids, conducted by Baron Cagniard de La Tour in 1822. The question that was up for solution was very much such a one as was propounded in the American Machinist a short time ago. The method adopted by De La Tour was such a very simple and ingenious one, that it would be a pity to leave out a description of it.

A small vessel was made having very thick iron sides, and closed by a strong lid. In the interior cavity was placed a little sphere of quartz, which was of such size as to rattle easily in the cavity when the vessel was shaken. Into the cavity containing the quartz ball was now poured ether till about half the remaining space was filled. The lid was put on and secured in place. Next De La Tour shook the vessel, and listened to the sound which the quartz ball made, which was naturally somewhat muffled by the ether cushion. When he was satisfied that he knew the sound thoroughly, he applied heat to the iron vessel, carrying it up slowly, shaking from time to time, and noting carefully the sound made by the quartz ball. He found that at a certain temperature, which repeated trials placed uniformly at about 187.5° centigrade (or 369.5° Fahrenheit), the sound of the ball suddenly changed. Up to this temperature the effect of the liquid in deadening the sound had been clearly perceptible, but now there was no such deadening at all. The ball rattled on shaking, just as if it were the only thing there. On allowing the temperature to fall slowly, he found that as soon as the temperature fell below the above-mentioned point, the deadening action returned. Experiments with other liquids, which could be vaporized at comparatively low temperatures, gave similar results. In every case a temperature could be found always far above the boiling point of the liquid (ether boils at 37° centigrade or 98.6° Fahrenheit) where the sound of the quartz ball showed that there was apparently no liquid in the interior cavity, but that all the liquid had been converted into vapor. The experiments made with water were not crowned with success. Great difficulty was experienced in keeping the joint between lid and vessel tight at the tremendous pressure naturally resulting from the formation of steam at such high temperatures. No results were obtained in this case which De La Tour thought worth mentioning; but he seems to have had no doubt but that the results would be the same as with other liquids, if the joints could be kept tight.

Next he made a second series of experiments, in which the liquids were sealed up in small but very thick, strong, glass tubes. The liquids were put in in such amounts as to occupy about ½ to ⅔ the interior space. Here the testimony of the quartz ball in former trials was completely verified. As that temperature peculiar to the liquid under examination was approached, the liquid which had been expanding steadily, as a well-behaved liquid should, began to disappear. The little bow-shaped line of separation between the liquid and the space above it began to grow ill defined, and finally disappeared altogether; the tube now *appeared* to be full of vapor and nothing else. It may seem strange to some that the experimenter should have concluded that such was actually the case, but in the light of then existing knowledge, no other conclusion was admissible. The generalization which he felt warranted in making from his experiments was a most memorable and notable one, the value and future results of which, we can be assured, he did not at all see. He concluded that there was a temperature peculiar to every liquid at which it was no longer capable of remaining liquid, no matter what the pressure was. To look at it from the other side, a vapor would stay vapor so long as the temperature was above this *critical temperature*. No pressure could condense it to a liquid.

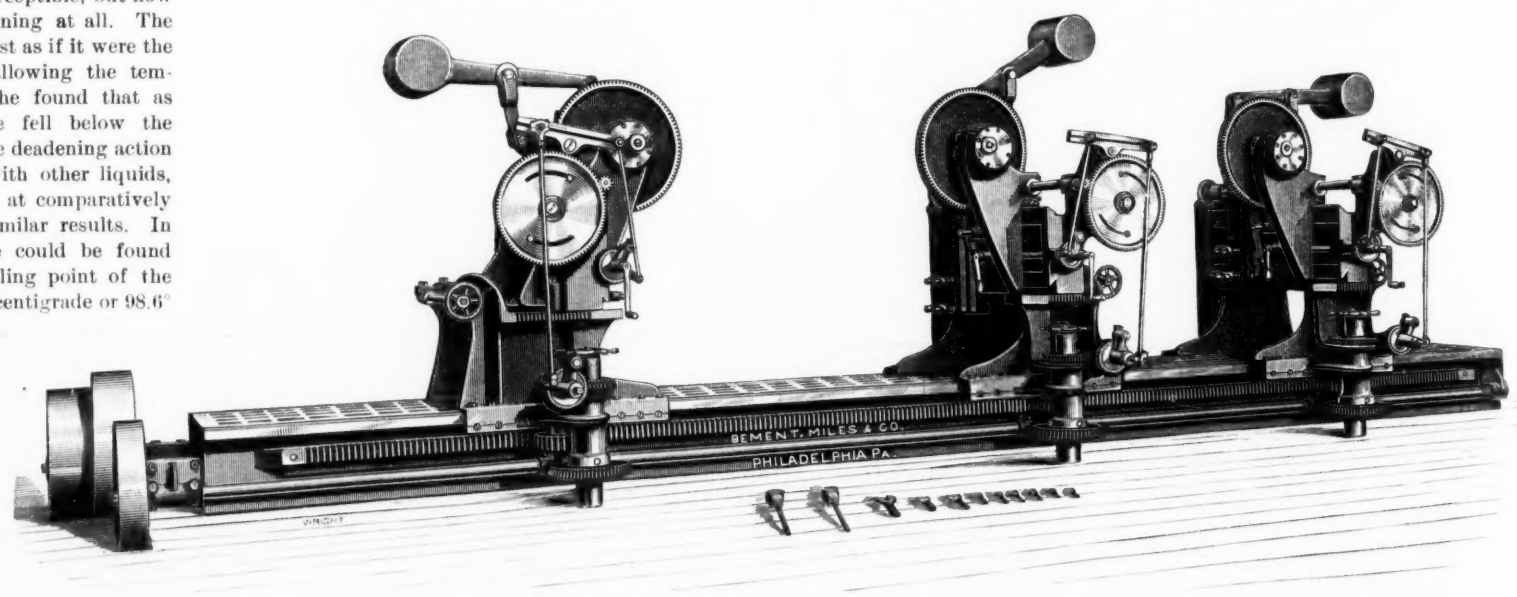
We can see about how much importance De La Tour attached to his work from the fact that he says that the persons he expects to be principally interested in his observations are those who have to do with steam engines. There is one more of his observations which may be mentioned. When the tube containing only vapor of the liquid at a temperature above its critical point was very slowly cooled down, and when the temperature was only a fraction of a degree above this point, the tube presented a very curious appearance. Its interior, particularly the part close to where the level of liquid was last seen, seemed filled with little transverse vibrating lines, something as when one looks along the edge of a hot stove, or along a bar of hot iron. As the temperature passed the critical point, the boundary between liquid and vapor became visible (I ought to have said long ago that the air was in every case expelled from the tubes before sealing them up for the experiment). In order for this curious and beautiful effect to take place, the temperature need rise only a very small amount above the critical point—just to where the boundary line disappears. Then on allowing it to fall very slowly, the effect takes place as stated.

When the temperature is *very suddenly* lowered considerably below the critical point, the effect is different. The tube becomes suddenly filled with a dense cloud, and the liquid appears almost immediately. If, conversely, the temperature of a liquid be very suddenly raised above the critical point, the liquid vanishes with almost equal suddenness, and the effects obtained by slow action are lost. All these observations were made by De La Tour.

It will be observed that in no case is any experiment recorded when the tube was *completely* filled with liquid. The difficulty of making such trials is very great indeed. Liquids are practically non-compressible, and the pressures exerted by them on expanding are enormous. To put the matter in a general way, the liquid in expanding a certain amount exerts just the pressure it would take to compress it back to its original bulk. We know fairly well the *coefficients of compressibility* of liquids; that is, *the very small fractions of their original volume by which they would be reduced by one atmosphere* (15 pounds per square inch) pressure. So we can calculate this pressure exerted by expansion. Take the case of mercury, for instance. When heated from 0° centigrade to 10° it expands by .001579 of its original volume. On the other hand, one atmosphere will only compress mercury by .00000295 of its volume, then to compress it back through .001579 of its original volume would take as many atmospheres as .00000295 is contained in .001579, or about 600. This makes a pressure of 9,000 pounds per square inch, which would be required to prevent mercury from expanding when heated from 0° to 10°.

It would be rather difficult to parallel the case for water, for as a matter of fact water has about the same density at 10° as at 0°, so it would only occupy a *very* little more space at 10° than at 0°, but, in general, water expands more rapidly than mercury, and is, at the same time, more compressible, so at high temperatures we shall not be very much misled if we use the mercury figure for water, for considering the pressure necessary to prevent the water from expanding while heating to its critical point, which is probably about 700° centigrade or 1,292° Fahrenheit, it will evidently be *at least* 70 times as great as from 0° to 10°. As a matter of fact it would be much more, but at the lowest estimate we should have a pressure of 630,000 pounds per square inch. Iron is, of course, very much weaker at a red heat (as this would be) than at ordinary temperatures, so it will readily be seen that a tube or ball, which was to hold, say, one cubic inch of water while heated to its critical point, would have to have pretty thick sides.

If, however, a tube could be made which would stand the pressure, and if all the other difficulties of such an experiment could be overcome, I see no reason for believing that the case would be different from that when less liquid is present. At all events, what was there at or a little above the critical point *would not be water*, and if the temperature was quite a little above the critical point, it would almost certainly be steam. The fact is, the question is too interesting a one to leave at this point, and so, although all has been said perhaps that would interest many, yet for the benefit of the few who may like to follow this matter out a little further, I shall ask the American Machinist for more space soon in which to consider this remarkable class of phenomena more fully, and see what light modern experiment can give us on the question which naturally suggests itself, *What is in the tube at the critical point, if not water?*



Triple Head Frame Slotter.—See Page 1.

Profit Sharing and the Labor Problem.

By A Workman.

This question is being brought prominently to the attention of the American public by the Association for the Promotion of Profit Sharing, whose stated object is to unite the interests of the employer and employed, and bring about a better understanding between them. That their interests are the same is a fact recognized by all teachers of political economy, but to make both parties in question look at the matter from that standpoint is the difficulty. To solve this difficulty is a problem worthy of the best efforts of the ablest minds interested in the welfare of the wage-earner. Mutual respect and confidence is the first requisite; does this feeling exist? In many instances the employer looks on the workmen only as a means to attain his own ends, without a thought of how his workmen live, what social position they occupy, or whether their earnings are sufficient to enable them to so educate their children that they may become citizens worthy of a free republic.

It is a pleasure to acknowledge that all employers are not of this class; that many are actuated by a sincere desire to better the condition of those in their employ, but are sometimes at a loss to determine the best means to employ to bring about the desired result, and often, owing to a lack of confidence on the part of those to be benefited, this lack of confidence is the greatest bar to a better understanding between employer and employed.

That there is a feeling of distrust in the minds of a majority of wage-earners against the representatives of capital is a fact that the careful observer will ascertain from intercourse with men in the workshop, and the general tendency of so-called labor organizations is to foster this feeling, and make wider the breach between capital and labor, when there should be no breach. Their interests being identical, each dependent on the other, perfect harmony is essential in their mutual relations, and until this harmony is established, no system of profit sharing can be successfully carried into effect. Workmen are too apt to take a narrow view of matters affecting their own interests, and often to their own detriment. A fact that illustrates this very forcibly is when an association is formed in a large manufacturing concern for mutual benefit, where by the payment of five cents per week the workman secures six dollars per week, if in case of sickness or accident he is unable to work. In one instance, and although in successful operation for several years, at no time has more than one-third of the employes in the works taken advantage of its benefits, many alleging that it was a scheme of the company's, and they would have nothing to do with it. This in the face of the fact that the association was organized by the workmen who had their own officers; the company having no hand in its formation. Independence, guided by common sense, is a spirit to be commended, but the man who, to show his seeming independence, frowns on everything that is proposed for mutual good, unless it originates with himself, is a crank.

While such antagonistic feeling exists in the minds of wage-earners on one side, and capitalists on the other, if only to a limited extent, the efforts of those interested should be directed to the education of both parties to the realization of their duties and responsibilities to each other, as well as to society. The fact stares us in the face that the States have had occasion frequently, of late years, to call on the military to suppress labor riots, the immediate cause being often difficult to locate, but the general cause is friction between capital and labor. It is growing to be a serious question, but if each party would put itself in the other's place, and look at the matter from that standpoint, the solution would not be diffi-

cult. It is only by mutual concessions that a satisfactory understanding can be arrived at. If the Association for the Promotion of Profit Sharing, and other organizations interested in the solution of this much vexed problem, will take hold of it with the energy that the importance of the question deserves, only good can result, even if they do not achieve the full measure of their ambition.

Thirty-six-inch Triple-geared Lathe.

The accompanying illustration is of a newly designed 36-inch triple-geared engine lathe, built by the Lodge & Davis Machine Tool Co., of Cincinnati, O.

The bed of this lathe is of great depth and massiveness. The head-stock is unusually long, and bolted to the bed at three points in its length. The face-plate is keyed to the main spindle, and is driven by a pinion gearing into an internal cut gear on the back of face-plate. Cone has 5 steps for 4-inch belt; largest diameter cone, 21 inches; smallest diameter, 8 inches. Fifteen changes of speeds are provided for.

The carriage is 50 inches long, is very heavy, and has large wearing surfaces, both on the bed and on the cross-slide; the apron is secured to it in such a manner as to lend additional stiffness. The carriage is gibbed both front and back.

The foot-stock has long continuous bearings on the ways, is unusually heavy, and is moved along the shears by means of the usual rack pinion and crank handle. It is held by four clamping bolts, and has set-over for tapers.

The reverse for feeds is placed in the apron, where it is at all times convenient to the hand of the operator. The compound rest is graduated, and has power feed in all directions. The automatic stop can be so arranged that any number of pieces can be turned or bored up to a given point without marking or further attention after stop is once set. The feed rod can be driven either by belt or gears. The spindles are of steel, the live spindle having ground bearings running in composition boxes, which are readily adjustable for wear. The lathe swings 38 inches over the ways, and 26½ inches over the carriage.

Recent reports are to the effect that the Japanese are making a quality of pig iron well adapted—as cast-iron goes—for the making of heavy guns, as demonstrated by actual tests.

The Brown wire-wound gun, recently tested at Birdsboro, Pa., is said to have withstood tests that would have demolished any other gun in existence.

Air Hoists.

By Frank Richards.

Those who have done me the favor of looking over the three or four articles that I have lately contributed to the American Machinist about compressed air, may think that, as far as I have got, I have apparently not made out a very favorable case for it, and that I do not favor its use. Folks mustn't get that idea into their heads, you know, because if anybody believes in compressed air, I am probably the fellow. We may later get to see that the case of compressed air is not as bad economically as I have put it, or rather, that there are ways of compensating for and balancing some of the apparent losses that may effectually turn the decision in favor of its application in many wide fields.

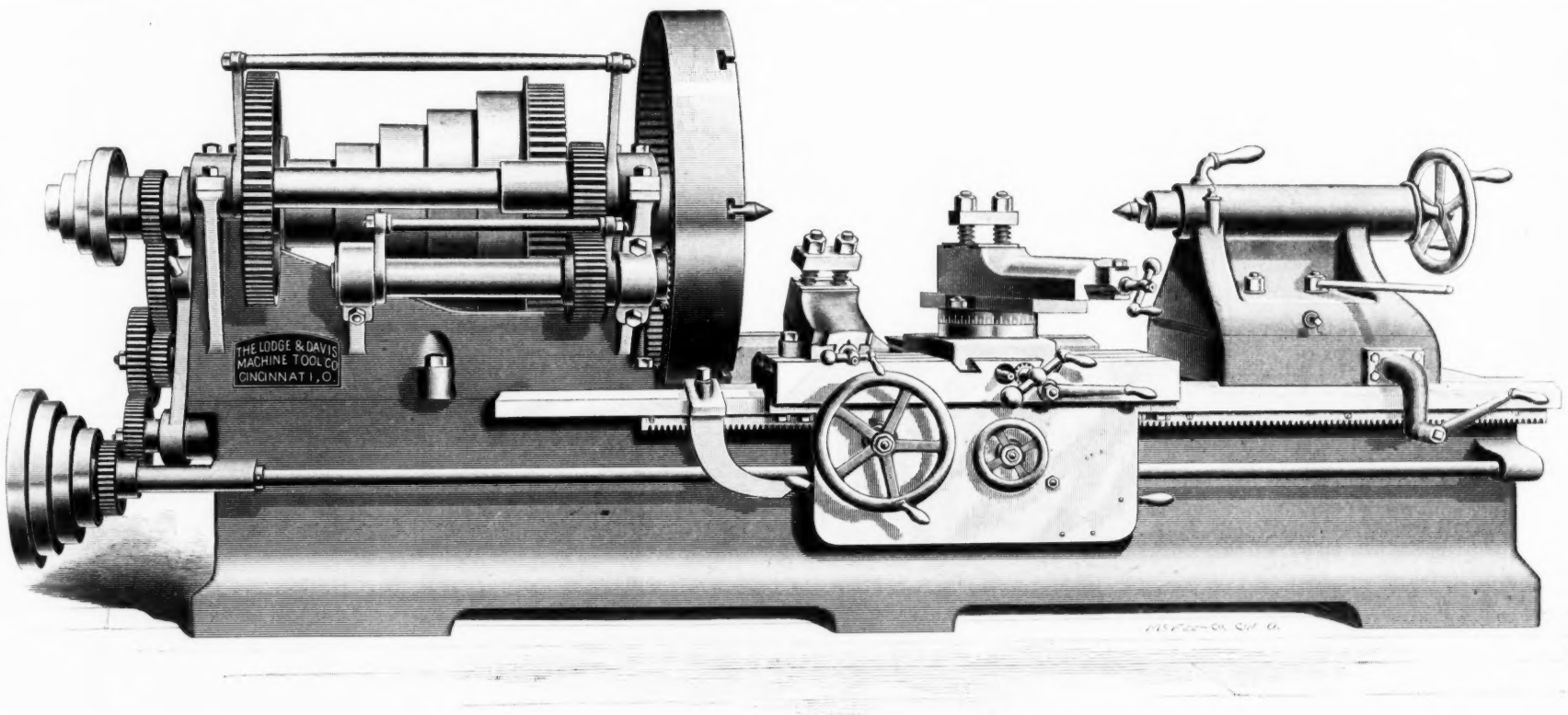
But there are purposes for which compressed air can be employed where the economy of it, or the actual power cost, cuts such an insignificant figure that it is not worth considering. This applies especially and almost universally to pneumatic hoisting. So far as the cost of the power employed is concerned, it is possible that the actual operation of hoisting could be accomplished more cheaply by some other means, but the air is so quick, so clean, so ready, and the mechanism required is so simple, that the cost has nothing to do with it.

Now I am not claiming that compressed air should be employed for hoisting always and everywhere. At the Wellman Iron and Steel Co.'s mill, at Chester, Pa., where they say they are able to roll the largest sheets of steel ever produced, I saw an electric traveling crane that seemed to be the right thing in the right place. The man operating the crane would bring the hoist over the middle of a big steel plate, and an electro-magnet would freeze to the plate, and the crane would pick it up and walk off with it, and drop it upon a car or wherever it was wanted with no trouble about hitching or unhitching, with nobody to look after it down below in any way. They shouldn't pay a man much for running such a crane at such work as that, because it is only play. But the same company hoist all their furnace doors, and do many other operations about their mill by compressed air, and they couldn't and wouldn't run their mill without it.

The Armour Packing Co., at Kansas City, Mo., can probably show as complete and satisfactory an equipment of pneumatic hoisting apparatus as can be found in this country. Their new packing house, built last year, where they kill over 2,000 head of cattle per day, is equipped throughout with air hoists, they having over 90 in operation in that one building. The building is of brick, strong and heavy, six stories high, and about 100x150 feet. The cattle are driven up an inclined run-way to the top story where the killing is done. They enter through two narrow passages near one end of the top floor. These passages extend into the room about 40 feet. The floor of them is about 2 feet above the floor of the room, and between these two passages is another one about 4 feet wide, and the floor of which is a couple of feet still higher than the passages for the cattle. As the first bullock to enter either passage gets into the end of it a door closes behind him, and behind the next one another door closes, and so on, so that when these doors are all closed there are a dozen cattle, six in each passage, and each animal is shut into a comfortable little box of his own, with nothing more to trouble him. Then a man on the raised central platform knocks the cattle on the head, one after the other, and they all immediately lie down. As soon as the first one drops an air hoist lifts a big door forming the outer side of the box, and the same operation also tips the bottom of the box, so that the animal slips out upon the floor. Then a chain is slung around the hind legs, and another air hoist yanks the animal up, so that its head clears the floor, and hooks it to a continuously traveling overhead railway that makes the circuit of the room, and it begins to move off at once. Almost as soon as it begins to move away its throat is cut, and when it has gone a few feet farther the head is off, and the carcasses all move along in endless procession suspended about 6 feet apart. The succeeding operations require more time than the killing, so that for each of the first series of hoists there are six or eight of the "droppers" that now come into play. As the carcasses come along they are successively switched off from the main line of track to other tracks at right angles to it, and at the end of each of these tracks the trolley runs upon a hook that is held up in place by a pressure of air sufficient to sustain the weight of the bullock, and upon letting off the air the carcass drops upon the floor, and it is immediately attacked by several specialists. The feet are cut off, the disrobing is commenced at the posterior extremity, and the entire front is unfastened. One man seemed to do nothing but saw breast bones. Another hoist is now attached to the hind legs and partially raises the subject. The skin is removed, the disemboweling is completed, the carcas is split in two, the hoist being manipulated to gradually raise the carcass as these operations go on. Then the halves move off toward the cooling and storage rooms, the other parts slip through their appropriate openings in the floor, and so it goes on day after day. It must make one hungry to think of it.

A slaughter house is a long way from a machine shop, but the air hoist is as applicable in the one place as in the other and in every industrial establishment between them. I can talk better about the air hoist in the machine shop than anywhere else, because there, if anywhere, I know what I am talking about all around, and who I am talking to. We know how the chain hoist has come to be universally used in the machine shop, so that it is difficult to imagine what we could do now without it. Well, wherever the chain hoist can be used, the air hoist can be used. That the air hoist has not been generally adopted before this is not easy of explanation. The trouble seems to be that only the single cylinder, direct acting, vertical hoist has been offered. Many of these have been sold, and they all give satisfaction where they are applicable. The great objection to them is that they require so much height that there are few places where they can be used. For instance for four feet of actual lift you must have in addition nine or ten feet above it for the hoist itself, and few shops have such a height to use, or even then could be satisfied with so short a lift.

This whole subject of air hoisting is certainly well worth looking into by every enterprising manufacturer. The cost of an air hoisting plant for general shop purposes is not large enough to frighten anybody.



Thirty-six-inch Triple-geared Lathe.

In most kinds of mechanical work the tendency during the past forty years has been towards an increased output, brought about mainly by the constantly increased efficiency of machines and tools. According to the *Cosmopolitan Magazine* this has not been the case in magazine printing. "Forty years ago," the *Cosmopolitan* says, "the magazine press printed more rapidly than the magazine presses of to-day." Six thousand sheets per day is the limit.

The Railroad Commission of South Carolina has tackled a big job. It is nothing less than attempting to restrain, by virtue of an "order," the operations of the baggage smasher on railroads. The genuine cowboy is fast disappearing, but the baggage smasher still survives in all his glory, and will laugh at "orders" issued by railroad commissions.

The new steamship "Campania" for the Cunard line is 620 feet in length, 65 feet wide, molded depth 43 feet, with a gross tonnage of 13,000. She is divided into 16 water-tight compartments. There are 1,350 electric lights, each 16 candle-power. It is said that the power of her engines will be much in excess of any so far placed in a steamer.

Improved Vertical Milling Machine.

We present with this an engraving of an improved vertical milling machine designed for a wide range of jobbing and manufacturing operations, including die sinking, surfacing, plain and circular work.

The spindle, which is driven by a belt at speeds suitable for cutters varying in diameter from 6″ (for surfacing) down to ⅛″ for the finest work, has a vertical adjustment of 4″, with means of locking the spindle slide at any point. The mills or arbors are held by a draw bar, which passes through the spindle, the latter being bored for Morse No. 4 taper shanks. It runs in long composition boxes, which are adjustable for wear, and is driven by a pulley 12″ diameter, 3″ face, supported upon a separate bearing, which is independently adjustable, and relieves the spindle of all side pull from the belt. The spindle is thus fitted to run at the very high speeds which make small cutters efficient.

The overhanging arm is carried well back to allow room for work of considerable size, and on the regular platen is mounted a circular one which may be rotated either by hand or automatically. This circular platen has T-slots, and is 20″ diameter. Work 32″ diameter can be swung upon this table, so that apertures up to 25″ may be readily milled inside.

The main platen is 35″ long, 10¼″ wide, and as the saddle on which it moves is of the same width, there is always a bearing sufficient for great stability.

Centers may be mounted upon the platen in the usual manner, and the machine is then adapted to grooving taps, reamers, cutting gears, etc.

Feed is derived in the manner shown, by means of a friction disk giving feeds from the finest to the coarsest ever required in either direction. The knee has a vertical adjustment of 16″, and the greatest distance between platen and end of spindle is 16½″.

Countershaft has double-friction clutch pulleys providing for two speeds, besides those provided for by the cone pulleys.

The machine may be used for boring and drilling also, and, as will readily be perceived, is adapted to a wide range of machine shop work. It is manufactured by the John Becker Mfg. Co., Fitchburg, Mass.

Coe Brass Manufacturing Company.

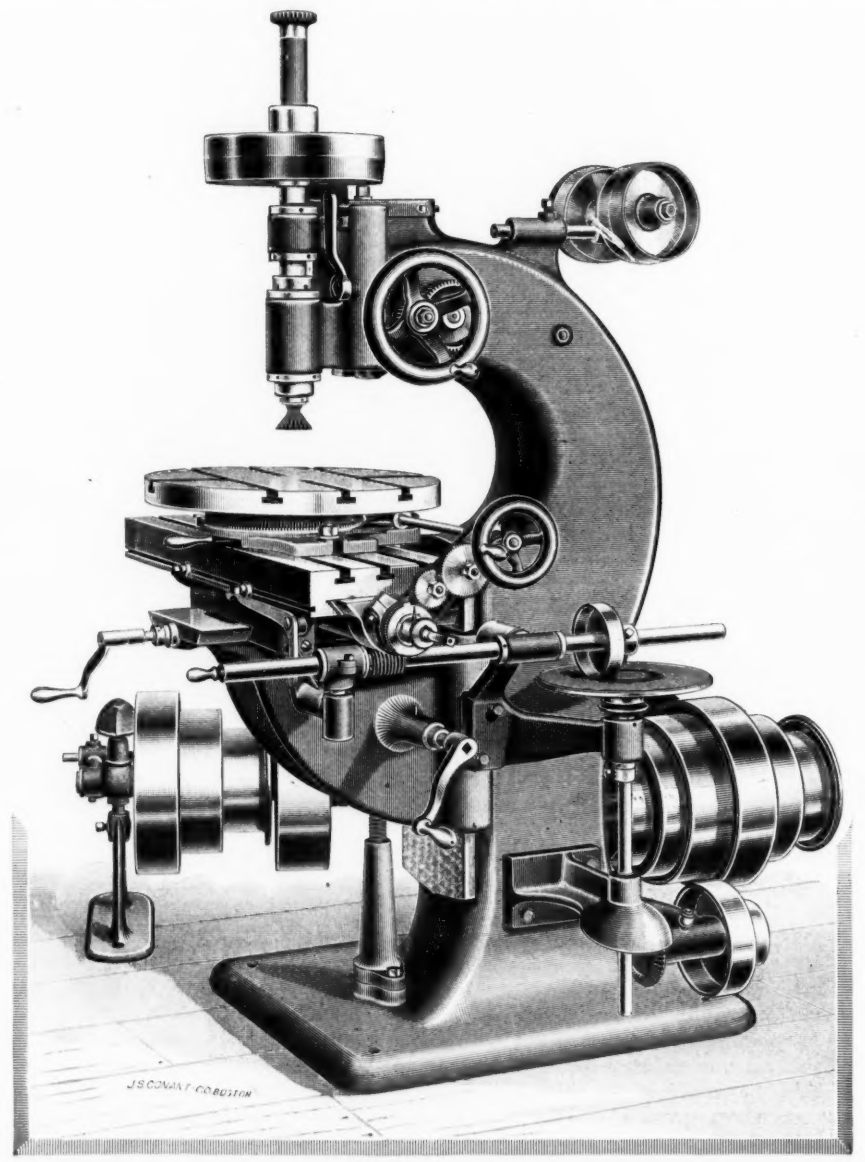
Editorial Correspondence.

The manufacture of brass wire and rods, sheet brass and brass tubing is a branch of mechanics which the average machinist knows little about, for the reason that such work is confined to comparatively few places, and relatively few machinists are employed in connection with it. This industry is one of the most important ones in Torrington, the Coe Company employing about 700 men and sending its products to nearly every part of the world.

The elder Mr. Coe, who died recently, founded the business, taking over the plant of the Wolcottville Brass Company, many years ago, when such work was really one of our "infant industries" (all the machinery that the new company acquired being contained in a building 80x90 feet), and many things now quite commonly achieved in it were unthought of. The works were originally supplied with power by an overshot water-wheel, which has long since been replaced by engines. Some of the original machinery of the older company could not be obtained in this country at the time it was installed and was brought over from England, and a curiosity now to be seen in the mill is a train of spur gearing comprising seven gears of from 4 feet to 8 feet diameter and 12 inches face, all running together at a rapid rate and working very quietly, though no two of them were produced by the same maker, and one of them came from England with the original plant, and has a square hole through it secured to a square shaft by keys or wedges driven in at the corners, and so driven as to true the wheel. All the gears are cast, and the old English gear compares very favorably with its modern American machine molded mates. All of them are excellent gear wheels.

Though there are several smaller engines about the place, the main part of the power is furnished by two Watts-Campbell tandem compound condensing engines of 500 and 600 horse-power, which stand upon foundations elevated 2 or 3 feet above the floor of the mill in which they stand. The rolling mill is considered one of the best arranged and most efficient plants of the kind in the world, and has a clear floor 120x230 feet, is built of brick, and with a Berlin Bridge Company's roof. The engine is at one side of this floor, but in the center of the length of the building. Running along under its crank-shaft, lengthwise of the building, is a tunnel in which is placed the shaft which is driven by the engine and from which the power is taken to drive the rolls.

This shaft is driven by means of a pair of Poole & Hunt machine molded spur gears, 11 feet diameter, 20 inches face, 7⅝ inches pitch, running at a speed of 39 feet per second. They have been in service since



Improved Vertical Machine.

1887 and are working excellently. The central section of shaft on which the lower gear is placed is 15 inches diameter, 21 feet long. The gears, shaft, couplings and hangers or pillow blocks are all from the same establishment and constitute a very creditable job of work. The tunnel is always lighted throughout with incandescent lamps, and there is plenty of room to walk along at one side of the shaft, which is near one side of the tunnel and raised above its floor on a masonry foundation. This arrangement of the driving power gives the least possible obstruction to the handling of material on the floor of the mill, the principal rolls being placed directly over the tunnel and driven by spur gears from the shaft.

The Sturtevant system of hot blast heating and ventilation is also in use here, and the building contains every convenience for comfortable working and efficient operation.

All brass manufacture starts with a brass casting. If sheets are to be rolled the casting or ingot will be comparatively broad, thin and long—possibly ¾ inch or an inch thick and from 3 to 14 inches wide. These are cast in molds of cast-iron which stand vertically or at a slight incline in a pit near the melting furnaces, and are filled from the top by pouring from a crucible, in the same way that other brass castings are made. If rods or wire are to be made, the casting will be of corresponding form; the molds being in all cases made in two parts, which are keyed together, so that the casting may be readily removed from it when sufficiently cooled. These castings are carefully cleaned and the rolling operations begin; this rolling, which, of course, is done cold, giving to the sheets their characteristic hardness and finish. The rolls must be very smooth and highly finished, and as the brass passes through them it is copiously lubricated, without which scarcely any reduction would be obtained and the results would be far less uniform.

At intervals during the rolling the pieces must be annealed in order to keep them soft enough to be readily rolled, and for this purpose a row of annealing furnaces are arranged along the side of the mill opposite the rolls—the pickling and washing vats being located on the floor between, so that the pickling and washing may be done in transit from the furnaces to the rolls.

After the first few passes, or in some cases before the first pass through the rolls, the slabs of brass are placed upon tables before men whose business it is to find and remove any scale, dirt or other impurity which may show upon the surface, and which, if not removed early in the process, gives trouble by leaving an indelible mark and an imperfection upon the finished sheet. Its removal is effected by the use of scrapers, which have an edge rounded so much as to make it certain that no scratches or sharp ridges will be left, as these, if present, will not be rolled out by the subsequent reduction, but will persist and be visible in the finished sheet, even though the reduction of thickness be very great. In rolling German silver into sheets they are scraped all over before the rolling process, in order to be sure there is no foreign substance imbedded in the surface.

The work to be annealed is placed upon large iron plates, which are carried upon hand trucks, and when near the furnaces a chain is attached to the plates in such a way that the plate with its load is pulled or rather pushed into the furnace by power, the same chain serving to draw the work out onto the trucks again when the heating is done. The furnaces, ten in number, are heated by chestnut wood, this being one of the few fuels that will answer for this purpose; any fuel containing the least trace of sulphur being especially objectionable.

This company is one of the largest manufacturers of brass tubing in the country, making both brazed and seamless tubing in a separate building 200x100 feet, which is devoted to this exclusively. Brazed tube making is of course an old process, but is here carried on in the best possible manner. A man takes a strip of sheet brass, whose width is equal to the circumference of the proposed tube. With a hammer he bends one end of it roughly into a form approaching that of a tube, and this end is then passed through a die, gripped by tongs and pulled through the die by power, the operation being essentially that of the draw-bench. Where the edges meet an open joint is formed, which is scraped out with a sharp wedge-shaped scraper which makes the edges bright and clean and leaves the opening V shaped. A boy very skillfully runs this V groove full of a special hard solder, which is granulated brass very finely divided by being pounded in a mortar while nearly red hot and mixed with borax. When it is to be used it is mixed with water to make it flow readily. When about half a dozen of these tubes are thus prepared they are passed through a furnace, which fuses the solder and completes the brazing, the joint being kept uppermost during this operation, and the tubes being pulled through by a workman who watches them closely and draws them through one after the other and a short distance at a time as the heating progresses to the desired stage, which he judges by the eye. After cooling, the joint is filed smooth, and the tube is given such outside finish as is required.

With the seamless tubing the process is entirely different, and though the machinery and appliances required for the work are very much more elaborate, I should judge that the cost of making this kind of tubing is less than that of brazed tubing, because it is made direct from a casting and requires far less hand labor.

A separate foundry is operated for making the castings for seamless tubing. The molds, as in the other case, are of cast iron, but are not in two parts; they are cylindrical in form, carefully bored in a lathe, and are provided with trunnions placed at each side, something after the style of a cannon. Upon these trunnions the molds are swung into a vertical position to be poured, and are then swung down into a horizontal position for the castings to be taken out, which can be readily done when the heat of the casting begins to be conducted to the mold, and the former consequently contracts while the latter expands. The casting is a tube in the first place, this being accomplished in the usual way by setting a core in the mold; this core, owing to its length and the necessity for having perfectly sound castings, being made with very great care. Its foundation is a perforated iron pipe termed a "core arbor," which is placed in supports upon a bench before a workman, who begins by covering it with a uniform layer of a peculiar swamp hay which comes from Indiana, and which has what may be called the felting property, *i. e.*, it has a tendency to cling together, owing to serrations or small barbs upon the surface of the stalks. This comes in bales, and is softened in hot water. The workman takes up a bunch of it and very skillfully winds it uniformly around the core arbor, which is turned by hand by an assistant, who temporarily attaches a hand crank to the end of it for that purpose. This surface of hay is covered

(*Continued on page 9.*)

LETTERS FROM PRACTICAL MEN.

Section-lined Paper.

Editor American Machinist:

I have followed with much interest the various communications regarding the use of section-lined paper, but in my particular case with a deepening impression of how much circumstances may alter cases. What may be a great labor-saver to one man may for the very next man prove only an expensive luxury.

So it is with the use of section paper; its value is most distinctly shown where sketches or drawings can be made full size. In my case by far the larger number of drawings that could be made on section paper are to a scale of one half inch = 1 foot, and of such a character that dimensions must be given, and that any prominence in the background, such as is given by cross lines, would be objectionable. But for ordinary sketch work the equal of cross-ruled paper cannot be found.

C. G. Sauls, in your issue of March 23, presents a truth recognized by all draftsmen, when he remarks regarding keeping copies of all drawings that "this gets rid of annoyance of the loss altogether of the sketch, which we all know will happen, no matter how careful we try to be." The question at once presents itself, is there any other simpler method of keeping copies than by blue-printing?

For a number of years I have successfully followed on an extensive scale the making of sketches in aniline copying pencil. This requires neither more effort nor skill than to use the ordinary lead pencil, while the result is capable of being copied in letter-press four or five times. The method pursued is to make one copy in a special copy book, and the desired shop copies on separate tissue sheets. Each of these is easily mounted with mucilage on cardboard, and forms all that is necessary for a shop drawing of the temporary character that these are designed to be. The original sheet is sent to the customer, and serves as his record and setting up drawing.

These sketches are always made on letter size sheets, and form most convenient drawings. A similar system would doubtless be absolutely useless in many lines of manufacture, but in this particular case it is the means of saving hundreds of dollars per year in the expense of making drawings.

Where expedition in work is all-important this scheme is particularly valuable, for it takes an hour or less to get a complete drawing into the shop (if the work be of a simple nature), whereas with the blue-print system, if the sketch were made in the afternoon of a winter day, it would have to wait until morning before a copy could be made.

The presence of all the sketches in a special series of copy books properly indexed makes it extremely simple to refer to them at any time. Suggestions and preliminary sketches for customers may be very economically made in this way, and inclosed with the letter concerning same. It seems to me that one of the first principles in the administration of a drafting room should be that copies should be there retained of everything that is sent from the room, except, perhaps, pattern drawings which are absent from the room only a short time, and which are pretty safe from soiling or injury.

Record keeping in this manner may be advanced in the case of pencil drawings by making them on bond paper in fairly soft pencil, and blue-printing therefrom. Sometimes tracings are sent to an office to have some details worked into them for a customer. A record blue-print of each drawing is easily made before they are returned, and will often prove of marked value for reference.

Mr. Sauls' remarks on drawing sizes are to the point. In these days of roll drawing paper, roll tracing cloth and roll blue-print paper of all qualities and widths, we have but little to do with the standard paper sizes of Whitmore's and similar makes, unless an exceptionally fine drawing is to be made. Why try to make standards of full, half and quarter-double depliant sheets when even the size we start with is unsatisfactory? I can answer Mr. Sauls that there is nothing the matter with buying paper in commercial rolls 36" wide. I have for years used 36" roll tracing cloth and blue-print paper, cutting to sizes 24"x36" and 18"x26", and more recently to 9"x12", with the possibility of a 12"x18" sheet if desired. With these sizes there is no waste of material.

All the drawings of any common machine manufacturing concern can be made on 18x24 or 18x26, if the rule is only laid down that they shall be. The 24x36 I was compelled to use for certain building plans, but do not require it for shop drawings proper, and the 9x12 has been utilized for tables, small sketch tracings and the like.

The habit of getting dimensions and information tabulated and inked in on tracing cloth is of great value, as it presents an easy form for extensive reproduction. Price list books, books of data, results of experiments, dimension sheets and the like can be worked up to great advantage. When one sets about this work it is amazing to see how many things can be standardized and haphazard methods of design or manufacture prevented. But every man must work out his own system for his own particular line of work, and no one scheme can be devised to meet all requirements.

Walter B. Snow.

Gear Teeth.

Editor American Machinist:

I noticed in your paper of April 6th Geo. B. Grant on "Haswell's Rule for Drawing Teeth Curves." He states that gear teeth of all sizes cannot be cut with a duplex cutter. If we insist on a decent respect to accuracy, I consider this a slur on me and my business, as *I* introduced the duplex cutter some four years ago for cutting the teeth of gears. The original duplex gear cutter I made to cut a pitch from 18 teeth (and this is as few teeth as ought to be used in a pinion) to a rack inclusive. This cutter cut a tooth of a uniform shape and size on all size gears, making the variation all in the space. This cutter machinists generally took to, and I have sold several hundred sets.

This cutter also could be used singly for cutting bevel gears, and is used for this purpose today. But I found certain machinists using these cutters for repair jobs, where B. & S. involute gears were originally used, wanted approximately the same shape again, and also some machinists were bound to use 15 and 12, and as small as 10 teeth. This I have completely overcome in my improved duplex cutter, patented January 31, 1893.

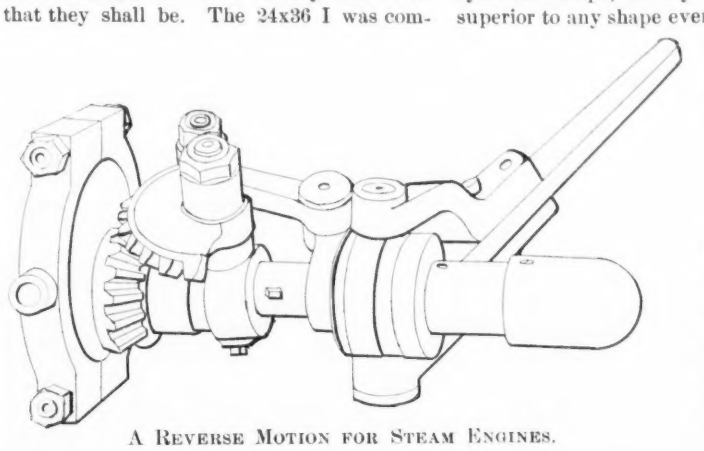
My cutters have the unqualified approval of some of the largest shops in this country.

Now as to accuracy. I will say $\frac{1}{2}$ of $\frac{1}{1000}$ of an inch is the limit of variation from the formula in the construction of these tools. And as to the shape of the tooth produced, I can give him (Mr. Grant) the variation for his standard in $\frac{1}{100}$ on gears at any point on the tooth of any size or pitch. I think he would have to split some of the *hairs* he tells of on some sizes.

A word now as to shape of tooth. The plain fact is, the involute tooth is probably the best shape for common or most gearing of 6 pitch and finer, but for coarser pitches and finer and noiseless running gearing the cycloidal shape, in my estimation, is far superior to any shape ever introduced in this country or any other country when properly cut and set.

R. M. Clough.

Tolland, Conn.



A Reverse Motion for Steam Engines.

A Correction.

Editor American Machinist:

In article entitled "The Ball Problem," issue of April 6, the printer makes me say that balls for bearings as they come from the makers measure from .002 to .004 of an inch large. Probably I neglected to put the proper number of ciphers on manuscript. I should say from .0002 to .0004 of an inch large; often are fully $\frac{1}{2}$ thousandth of an inch (.0005) above size.

I have before me 9 balls: 3 are $\frac{5}{16}$ inch diameter; 3 are $\frac{1}{4}$ inch diameter and 3 are $\frac{3}{16}$ inch diameter. The exact sizes are .3125, .3128 and .3118 inch—.2502, .2503 and .2505 inch—.1880, .1875 and .1882 inch. Two only out of the 9 are correct size.

Also in the first example, I gave the wrong table number for chord. I gave 6.248 inches. I should have given 6.211 inches. Corrected it figures thus: $12' \times .5'' = 6.000'' \div 6.211'' = .966'' \times 2 = 1.932'' + .5 = 2.432''$.—Ans.

Francis W. Clough.

A Reverse Motion for Steam Engines.

Editor American Machinist:

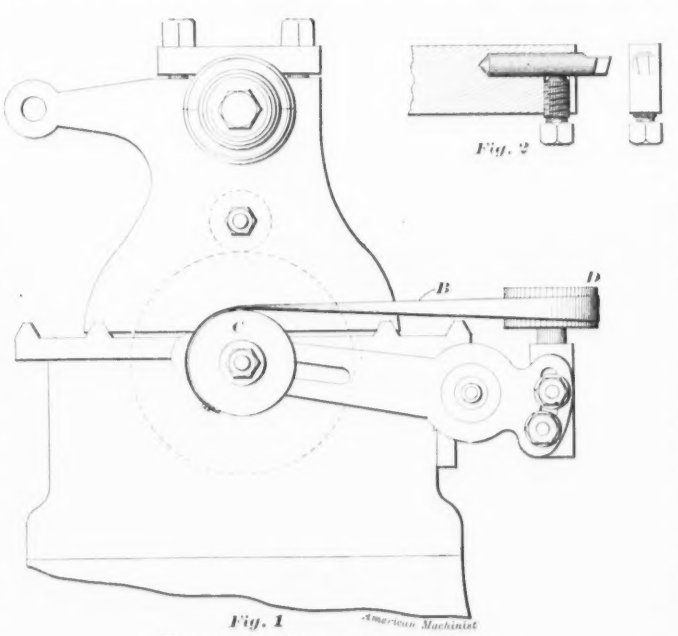
The accompanying illustration shows a simple reverse motion which has been in successful use and which I designed.

It consists of an eccentric whose position in relation to the crank is controlled by the reverse lever. The eccentric is free to revolve on the crank-shaft, and has attached to it a sector of a miter gear engaging with another sector which works freely on a pin fastened to the shaft. This sector is connected by means of a short link to a splined sleeve, which is free to move horizontally with the axis of the shaft, as shown in photograph.

A lug on the crank-shaft will allow the eccentric the proper forward or aft position.

When reverse motion is being used on traction engines it will serve as a brake in going down hill, and can be so regulated as to control the rig perfectly in going down a steep hill.

J. O. Haas.



Cutting a Coarse Pitch Worm.

Cutting a Coarse Pitch Worm—A Handy Lathe Tool—Safety Appliance Aboard Steam Vessels.

Editor American Machinist:

Some time ago I had a worm to cut of 2" pitch on stock 2" in diameter.

A very light engine lathe seemed to be the only thing available at the time, and after thinking over several ways that might be used, I decided upon the way I show here as the best, under the conditions, and after trial I had no reason to change my mind.

Fig. 1 shows the rear end of lathe with the rigging in place, which consists of the strap or band of steel *B* (which, in my case, was a piece of clock spring) with one end fastened to the wheel *C*, which wheel is held by a set-screw upon the hub of intermediate gear. The band passes around the idler *D* and then attached to carriage. This band winding upon the wheel *C* draws the carriage along, and a weight and cord (not shown) at back end of lathe draws the carriage back. It will be seen that putting a quarter twist in the band causes it to be a little elastic, so I found it necessary to use quite a heavy weight to keep the band taut. It will also be seen that the wheel *C* must not make a full revolution, for in that case the band would overlap and cause the pitch to increase. To cut the worm of 2" pitch I figured in this way: The worm was to be cut only 4" in length, so it is plain that the circumference of wheel *C* must travel just 4" while the spindle makes two revolutions. I found it convenient in my case to use gears 1 to 4, so that the intermediate gear, or what was in this case the driven gear, made $\frac{1}{4}$ revolution to two of the spindle. Then it only remained to make the wheel *C* of a size that $\frac{1}{2}$ its circumference would be equal to 4", or rather that its circumference would be equal to 8" less thickness of band.

In cutting this worm I used a tool like is shown in Fig. 2. Steel for the body 1"x$\frac{1}{2}$", with cutter of $\frac{3}{8}$" Stubbs steel rod and $\frac{3}{8}$ inch set screw, will make a very good one for a light lathe.

This tool has the advantage of being adapted to change the angle of cutter to suit the thread being cut, and that as Stubbs steel is better stock than the average steel used for lathe tools, the cutter stands up better. Many different kinds of cutters can be used in this holder, such as small boring tools, and a great many different shapes to suit the work at hand can be made quickly and cheaply.

Perhaps there might be an objection to loading a vessel with safety appliances and then leaving the passengers and cargo behind, but it seems to me that there could be more extensive pumping machinery aboard a steam vessel without very much extra weight.

Perhaps if the "Naronic" had been better supplied with pumping machinery she might now be at a different port than she is thought. She had power enough aboard to pump out a great quantity of water, but that power was only adapted to propel the vessel by turning the screw.

Now would it not be practicable to have a large pump of a suitable kind—perhaps a centrifugal pump—so arranged and connected with the main propeller shaft and the sea, at the stern of vessel, that it could be quickly started, and made to use a large part of the power of the main engines in pumping water, and by discharging the water behind, be of some use in propelling the vessel ahead? Perhaps a circular tunnel around the propeller shaft at the stern of vessel inside, made of boiler iron, with screw propellers inside on the shaft, back end of circular shell or tunnel being connected by large pipes closed by gate valves with the sea, the front end of tunnel being connected by pipes to the different bulkheads through the vessel, so that it could be made to discharge water from any section of the vessel, might answer the purpose.

A Mechanic.

Standard Sizes of Keyways—Writing on Blue-prints—Side Tools.

Editor American Machinist:

Your correspondents writing on this subject seem to all agree that it would be desirable to have a standard size for keys used in general machine construction, but none of them seem to be aware of what has been done in this direction, outside of their personal experience.

A system of standard sizes with gauges for maintaining the same has been offered in the machinery market for a few years, and I know of two machine shops of considerable size which have adopted and are using the same. This system is by Julius Roemmele, of Glasgow. The formula for the sizes are: Width of key = ¼ diameter of shaft + ⅛″; thickness ½ of width and depth in shaft $\frac{4}{11}$ of thickness. The gauges are made of flat steel about ⅛″ thick, hardened and finished to the width, and having a mark at the edge showing the depth to cut the keyseat in the shaft. The gauge is extended to the form of a cross, the two side arms being bent at a right angle so the bent part may be brought to bear against the inside of the bore of a wheel while the gauge end will rest on the end of the hub, giving at once the depth of the keyway and locating it so the center line of keyway will go through the center of the hole. With the gauge in this position a scriber may be used to mark off the keyway on the end of the hub without any measuring whatever. In fact this last-mentioned feature is the most convenient thing about the system.

The chief objections to this system are that it does not specify what the taper should be nor at which end of the hub the thickness should be measured. Also the gauges cannot be used to lay off the keyway on the hub for any but nearly the sized hole for which it was made, because if used on a smaller or larger hole it makes considerable difference in the depth of the keyway, and to have a different gauge for each fractional sized shaft would be too expensive. All the above objections can be overcome by improvements, and to say the least it deserves mention as being the first attempt to bring into general use a standard system of keyway sizes. The sizes given by this formula are, I think, slightly greater than the average of those in use, but it has the advantage of not giving such a trifling key to make and drive on the smaller shafts, and it is on the safe side of average practice. Of course, I suppose no one would think it desirable to strictly follow a formula for the sizes but use the nearest thirty second for thickness and nearest sixteenth for width. For instance, the size for all shafts from 1″ and sizes less than 1¼″ the keyway would be ⅜″ wide, and from 1¼″ up to all sizes less than 1½″ make the key $\frac{7}{16}$″ wide.

Mr. Pryibil correctly states the necessity for a difference in thickness according to length, but I cannot see any serious objection to making the thickness at the small end the same for all keys of the same width. It is true that it is more convenient to have the deep end of the keyseat up when cutting it on a slotter, but the depth at that end can be determined by a slight calculation by the taper and length when the depth at the small end is fixed, and the same method would have to be used if the thickness was taken at the center as suggested by Mr. Pryibil. Taking all things in consideration I think it would be best to establish the standard thickness at the point.

On the question of taper, I think Mr. Shellenback is right in saying that a key should not have less than ¼″ taper per foot, on account of driving it out. There need be no fear of a key working out with that much taper, for I have known them to stay when they had as much as ⅜″ per foot taper. A key of this taper is also more easily fitted, because it can be tried in place and removed more readily to show where filing is needed.

One of your correspondents in describing how to make corrections on blue-prints mentions that when the paper has not a good surface the soda water used for writing will spread and run together.

Much of the paper now used for blue-printing is of a poor quality, and for some time I was annoyed with the same difficulty, but I saw lime water recommended in the American Machinist for the same purpose, and since using that I have yet to find a blue-print paper so poor that I cannot make perfectly clear and smooth white letters on. To have success with it, get fresh, very white lime and dissolve it in just sufficient water to keep it entirely covered. Shake it before using so that the particles of lime will be in suspension when the pen is dipped in, for clear lime water, no matter how strong, will not be satisfactory, as it seems to be the lime itself that neutralizes the blue color.

The side tool shown by "A Mechanic" in January looked to me like an old friend, for when I was a jour. I carried around with me a pattern of such a tool to show the blacksmith how I wanted it made, and I suppose that improvement on side tools has been made by dozens of good machinists in various parts of the country, for it was improved before I came on the scene.

It is a good tool, but it requires more care and skill to use it than the old style, for it is weakened a considerable amount, and that, I think, is one reason why it has not come into more general use.

I have seen a machinist who made his first trial of one of them for facing the rough end of a shaft down to the center, give it up in disgust because it sprung into the work and caught, breaking the point. A few experiences of this kind made me cautious about recommending its use to any one unless he were a careful mechanic. Bell Crank.

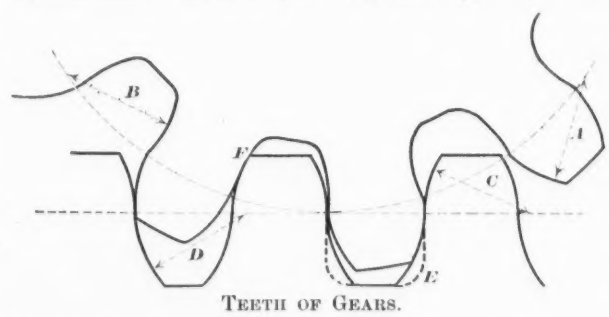
Teeth of Gears.

Editor American Machinist:

I would like to say a few words in regard to Mr. George B. Grant's criticism of Haswell's method of laying out the teeth of gears. If the engraving in Haswell's "Mechanics and Engineers' Pocket-book" is anywhere near the truth, it is evident that 1.25 of the pitch is not intended as the radius for describing the faces of the teeth, for by measurement the radius measures .5 + .125 of the pitch, or, in other words, ⅝ of the chordal pitch will be the radius for describing the arcs.

Assuming this to be correct, it may be shown that a pinion of 10 teeth will work and work well with a rack, or that any gears with corresponding pitches will mesh without binding, by describing the faces and flanks from points on the pitch line or circle, the radius employed for delineating the curves never being greater than the chordal pitch.

The drawing shows a pinion of 10 teeth working in a rack, but unlike Mr. Grant's representation of Haswell's gear teeth, there



Teeth of Gears.

is no interference, they simply wipe into each other as shown at *F*. Probably many mechanics might object to this, claiming that by other methods the teeth will roll on each other. I never found this to be entirely so, when observing actual gears or models in motion, whether involute or epicycloid in shape.

A and *C* are the radii for drawing the faces of the pinion and rack; but the flanks of the pinion teeth instead of being radial lines are arcs of circles, as shown at *B*, using ⅝ of the chordal pitch for radius as employed for the faces.

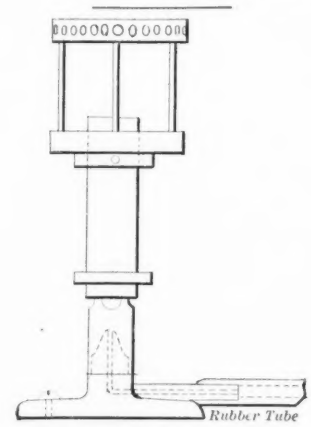
The flanks of the rack teeth may also be arcs of circles or lines drawn perpendicular to the pitch line, in which case it would be necessary to use the fillets *E* for strength.

All gears made by this rule having the same pitch are interchangeable. I have designed at times gears on a similar principle up to 4″ chordal pitch, which have given entire satisfaction. An elaborate table of chord pitches is in the late editions of "Nystrom's Pocket-book of Mechanics." When constructing a gear, its diameter should be found by reference to a table and not by trial, in attempting to step off the pitch on try, try again circles, for in doing so the chances are that inaccuracies will occur, especially if the gears are large.

No clearance between the teeth is shown in the drawing, as it is merely intended to demonstrate the fact that gear teeth may be laid out by arcs of circles, the centers of which are always on the pitch lines.

In the foregoing remarks it must not be understood that the gears spoken of as constructed had the teeth curves laid out with a radius ⅝ of the pitch, as this distance may equal the chord pitch if preferred, the objection to which is that the pinion teeth are weak at the roots.

Charles A. Calvert.



Hardening Small Work.

Editor American Machinist:

Here is another appliance I have devised for hardening the ends of small punches ⅛″ diameter and jaws $\frac{3}{16}$″. I make them by the thousand. They must be hardened swiftly and properly and just on the end. This is an ordinary Bunsen burner mounted on a solid base and screwed to the bench; the holder revolves and can be adjusted to any height; the work can be put in any distance to get desired heat; the flame can be adjusted to prevent overheating; the holes can be made any size or shape within the capacity of the flame. It is simple and cheap, and will keep two fellows humping to take the pieces out and put them in quick enough to make time. E. Hardinge.

Ball Problem.

Editor American Machinist:

Mr. Clough's rule for solving the ball problem involves a useless amount of computation. Multiplying both sides of an equation by a common factor does not add to the accuracy of the result, although making a drawing to an enlarged scale may. If Mr. Clough will divide the diameter of *one* ball by the sine of *half* the included angle he will get directly the diameter of the circle, in which the centers of the balls will lie, to such a degree of accuracy as will puzzle the machinist to execute in metal.

There is some discrepancy in the value of the chord taken by him, when compared with Trautwine's tables. As he obtained the value of the error in his graphic delineation (.008) correctly, the discrepancy does not appear to be in the tables used. Whatever fault may be found with his mathematics, none can be found with his drafting. The determination of the diameter of a circle that will circumscribe twelve circles of .5″ diameter within .01″ of the minimum is something to be proud of. He belongs at the head of the class.

In the given problem sine of 15° = .258819 (Trautwine) and .5 ÷ .258819 = 1.9318519 +.

Adding .5 we get.....2.431852 —
Value obtained by drafting.....2.440000

Error in draft..... .008148

Superannuated.

Section Paper—Rope-driving.

Editor American Machinist:

I was pleased to find Mr. Norris in the issue for February 2d putting in a good word for section paper as its merits, for some reason, are far from being adequately appreciated by the English-speaking engineering fraternity. For some years I have adopted a plan which, under some circumstances, has advantages over ordinary section paper. Upon a few sheets of card of various sizes I have ruled black lines similar to those on section paper, some spaced in eighths of an inch, and others metrically divided. Over any suitable one of these I fix a sheet of white transparent paper, and as these lines on the card underneath can be plainly distinguished, practically all the good points of section paper are secured by a method which has, among other advantages, the merit of being less expensive than the other.

With regard to Mr. W. H. Booth's interesting comments on "Rope-driving," and his reference to my articles thereon, I would point out that the unequal wedging of the ropes was discussed in the second article (December 1st issue), all the several points noted having been dealt with in that and the previous article. The question Mr. Booth raises as to whether fibrous ropes will not work satisfactorily in semi-circular grooves opens up an interesting aspect of the subject, and one which I think requires to be considered from more than one point of view.

Considering first the composite rope consisting of a wire core upon which a series of leather disks or washers is tightly threaded; these, as Mr. Booth is probably aware, are seldom used now, their relatively great cost as compared with cotton or hemp, the difficulty of splicing, etc., forming serious objections to their use, and to this there has to be added the somewhat greater cost of turning the semi-circular grooves in the wheels. Nevertheless the arrangement appears to possess several advantageous features, in addition to those enumerated by Mr. Booth. The resistance to bending, for instance, will be less than with hemp or cotton ropes, as the washers will readily accommodate themselves to the curvature of the pulley as they pass round it. This is a feature of some importance, and one, moreover, not possessed either by built up V-shaped or square leather ropes, to which fact the abandonment of the former of these types has been largely due. To square leather ropes the same objection applies, but to a much less extent. My experience with this latter form has led me to the conclusion that, for some purposes and when not too highly stressed, it gives good satisfaction in working.

Then, again, the composite rope has the advantage of offering the part of the leather to the pulley best calculated to secure grip. With regard to the latter point it would, I think, be quite reasonable to take 0.4 as the coefficient of friction, while with cotton ropes of the same diameter and used under similar conditions, not more than 0.2 could be counted upon. Finally, the composite wire and leather rope is practically non extensible and remains of uniform diameter throughout. With fibrous ropes, on the other hand, the driving side will always stretch to a greater extent than the slack side, and the sectional area of the rope at the point where it leaves the groove of the driven pulley will be somewhat less than the slack side section. It follows that, in the case of the semi-circular groove, if the rope on the slack side snugly filled the groove of the driven pulley as it entered it, it would not do so as it passed around the pulley, owing to the gradual reduction of the cross-section consequent upon the increasing stress to which it is subjected. Of course, deprived of its side support the rope would flatten to some extent and thus form a more intimate contact with the groove, this flat-

tening increasing as the stress increases. Probably the net effect would be to make the grip tolerably uniform throughout the arc of contact.

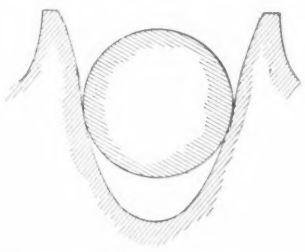
Contrasting this with the action of a rope running in a V-groove, it is at once seen that, owing to the wedge action due to the inclined sides, a greatly increased grip is obtained with much less surface contact. In this case the elasticity of the fibrous rope asserts itself, and in endeavoring to recover its circular form it insures an intimate contact between the working surfaces of the rope and pulley. I think it is fair to assume that of two similar ropes, one running in a semi-circular groove and the other in a 45° groove, the grip of the latter would, other things being equal, be at least double that in the former case, so far as it depends upon the wedge action.

But there is another factor to be taken into account. In entering the groove of the driven pulley the rope is subject to a stress of say 60 pounds, this gradually increasing throughout the arc of contact until the point of release is reached when the tension is, we will assume, 300 pounds. As pointed out in my first article, this gradually augmenting stress causes the rope to sink deeper into the groove as the point of release is approached, so that the "pitch line" of the surfaces in contact forms actually a spiral of small radial difference. It will be seen, therefore, that for the rope to slip on the pulley, not only the grip due to the *radial* wedge action of the groove, but in addition what, for want of a better term, I will call the *circumferential* wedge action, must also be overcome before slipping can occur. Nothing of this kind obtains in the case of the rope running in a semi-circular groove. On the contrary, the tendency is, as we have seen, probably to induce an effect of quite an opposite kind.

All things considered, it does not appear to me that satisfactory results could be obtained with fibrous ropes running in semi-circular grooves under the present conditions of working. Of course by sufficiently reducing the power transmitted by each rope such a plan could be made to answer well enough, but this entails the use of a larger number of ropes, wider and heavier driving drums, which means increased journal friction, space occupied and interest on first cost, risk of breakdown of ropes, etc. Against this is to be set the saving due to the prevention of wedging of the ropes into the grooves and of unequal slip, while an additional allowance must be made for the prolonged life of the rope consequent upon the reduction of the working stress. The tendency, however, at the present time appears to be towards *increasing* the working stress of the ropes, and more than one case has recently come under my notice where two, three, or even more ropes of a set have been removed with a marked gain in economy. The point at issue here is whether it is cheaper to buy ropes than fuel, and so far as present appearances go, it would seem that the latter commodity is still the dearer of the two. It is probable, therefore, that in the future we shall have still more highly stressed ropes used until the balance of economy and convenience is struck. This may appear a very primitive method of determining the best conditions for rope transmission, but it must be remembered that there is practically no reliable data available as to the life of ropes variously stressed.

Mr. Booth agrees with me that 45 degrees is a very usual angle for the grooves, but remarks that he has seen *sharper* angles used. It would, of course, have better advanced his claim if he had referred to the use of more *obtuse* angles, such as are still occasionally met with. Angles of between 50 and 60 degrees are sometimes used, but although a very large amount of experimenting has been done in this direction, we find angles more obtuse than the latter only very rarely employed, and this, to my mind, points very conclusively to the fact that beyond about 60 degrees the grip of the rope is insufficient even although assisted by the wedge action of the grooves. No doubt by lining semi-circular grooves with leather, vulcanized fiber, or some similar material, a very satisfactory driving could be obtained, but the cost of such a process would, I fear, be prohibitive.

Finally, I would suggest that some interesting and valuable information might be



obtained by experimenting with a groove which should be a compromise between the V and the semi-circular form, such as roughly indicated in the sketch herewith.

M. E.

Getting a Technical Education.

Editor American Machinist:

A short time ago a young correspondent of the American Machinist asked through the columns of Questions and Answers what course would be best for him to pursue in order to learn mechanical drawing. The answer was that the Michigan Agricultural and Mechanical College of Lansing, Michigan, provides for students to work part of the day and pay their way almost entirely through a course of four years in mechanical or civil engineering. While this is true, it is by no means the only institution of the kind in the country at which a young man may receive an education through his own efforts. At the State university or college of almost all of the States a young man with sufficient push and energy may receive an education through his own efforts. That it is no small undertaking for a young man to start into a four years' college course without some assistance, aside from what he may earn himself, cannot for a minute be doubted, but there are dozens of men doing that very thing to-day. At the University of Illinois within the past seven years there has not been a class graduate, but has had at least one member "who worked his way through."

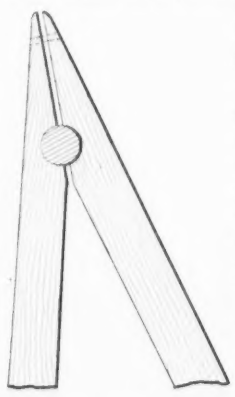
To all young men wishing a college education in an engineering course, and who have not the means to take them through college, I would advise to write to their State college or university for information. College authorities are always ready and willing to help young men along who wish an education. If your own State does not possess the proper institution write to neighboring States for catalogues, and if you really wish a college education you will find that where there's a will there's a way.

E. Spencer.

Draftsman's Wooden Triangles.

Editor American Machinist:

You are no doubt well aware of the propensity possessed by all (or nearly all) wooden triangles as used by draftsmen to change shape by shrinkage, and the framed ones get long on the points, making all sides hollow. Some two years ago I had use for a large triangle of 30°, 60° and 90°, and so made one in which I used the following plan to avoid this change of shape at the corners, and to day it is practically straight on each of its sides, although nothing has been done to it since it was made.



As the change of shape of the corners comes from the wood on each side, when shrinking, backing up against the adjacent side, the remedy is to keep the sides from meeting at the joint. This I accomplished by slightly separating the joints, and fitting into a circular recess at each angle and on opposite sides a cross-grained key or spline glued in; the recess was formed with a Foerstner bit.

The tendency of the extreme corners to slip by each other is overcome by putting a dowel pin through the corner and gluing it in one side only. As the extreme sharp corner is seldom or never used, I rounded it over to avoid catching and slivering.

Charles S. Beach.

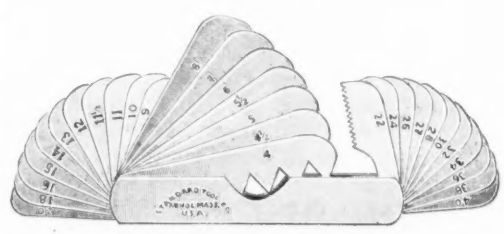
Columbian Exposition Notes.

FUEL OIL PLANT.

About the 1st of March fuel oil was first used under the boilers of the power plant. And the sudden transformation from soot, dirt, and, at times, the blackest of black smoke, to a clean boiler room and a clear sky demonstrated in a most positive manner the wisdom of the mechanical engineer and the other officers of the Exposition in choosing petroleum for its boilers—in preference to soft coal at least.

Whether or not gas, which also received some attention, would have equal advantages with petroleum is a question, but considering the cleanliness of oil both in the handling and in the consumption, with the additional and very important advantage, that of reliability of supply, the decision was a wise one. All the oil required during the year 1893 is to be furnished by no other than the Standard Oil Co., and they hold themselves responsible for its delivery. The contract price is 72½ cents per barrel of 42 gallons.

The fuel oil plant is located in the extreme southeast corner of the Exposition grounds. Here it is as far as possible from



Screw Pitch Cauge.

the buildings—a safeguard against fire, and at a point where all operations such as unloading from cars and pumping can be carried on at all times without hurting the fine sensibilities of any one.

The plant consists of a tank house and a pump house. The former is a vault covered with loam and grass, built of brick, with a heavy concrete floor and a roof of I beams supporting arched brickwork. The whole is divided into six distinct vaults by brick partitions. The entire tank house measures 68x74 feet and its depth is 12 feet. There are twelve oil tanks, two in each compartment. Each tank measures 8 feet diameter by 25 feet long. They are built of $\frac{3}{16}$ iron and have a capacity of 9,370 gallons each.

The pump house is located just east of the vaults and is fitted up with two duplex screw pumps for pumping oil, two 40 horse-power boilers, with suitable feed pump heater, etc., and a stand pipe 30 feet high.

The piping for the pump house and vaults was laid out with the greatest care, the object being to guard against any possible failure in the oil supply. The oil is pumped from Whiting, Ind.—about 40 miles distant—directly into the oil tanks. From the tanks it is drawn by one of the Snow pumps and forced into the stand pipe; thence it flows under a head of about 28 feet to the boilers. In case of the line from Indiana breaking down, oil can be drawn by one of the pumps from tank cars on a siding near into the vaults while the other is keeping up a steady supply to the boiler house. Again, should anything happen to the vaults the oil can be forced directly to the boilers from the supply line or the cars; again, the stand pipe may be shut out.

The amount of oil consumed is measured by an outage scale on each tank, a very accurate record being kept of the readings on each when full, and when at the low mark, or just before filling again.

The oil flows from the pump house to the boiler house through a 5″ wrought-iron pipe. This pipe is inclosed in a plank box, and with it a 2″ steam pipe, which serves to keep the oil from becoming sluggish in cold weather. This line is perfectly straight, and is 3,200 feet long. It is so graded as to drain back toward the pump house, so that the oil may be drawn from it immediately in case of fire in the boiler house. This line strikes the boiler house near the center, passes into it to a point just in front of the boilers; it then runs in both directions down the building to each end. It lies in a plank box laid in the floor. At each battery a branch is taken off the main line.

Surveys and drawings are now being made for a second line between the pump and the boiler house. This line will be 6″ diameter and will not be so direct, though it will drain back, as does the other. With these two lines there can be no danger of a shut down in case one line is disabled, as either pipe is large enough to supply all the oil required.

A 2″ steam pipe is run over each boiler, and branches from these lead down to the burners. Then these headers are so connected with the corresponding pipes for the other boilers, that steam may be had from any boiler which may be steaming at the time, to start any other boiler in the plant.

The power required from the boiler plant has been variously estimated at from 20,000 to 30,000 horse-power. The indications now are that the latter is much the closer figure, when the power plant proper, the line shafting engines and steam, as such, required by exhibitors are taken into account.

A system of electric valves, gauges and alarms will connect the fuel oil plant and the boiler house in such manner that supply and pressure of oil and steam, and supply of feed water as well, will be most perfectly regulated automatically.

Each boiler maker chooses the burners for his own boilers, and they are as follows: The Root and National have the Reed burners. The International and Reed burners are used under the Heine, and the Armstrong under the Gill. The Larkin and Pine burners have been chosen for the Babcock & Wilcox boilers. For the others no choice has been made as yet.

Screw Pitch Gauge.

The accompanying illustration is of a new screw pitch gauge, which determines all pitches in common use from 4 to 40 per inch, including those for pipe and brass work—11½ and 27 per inch. The leaves are made sufficiently narrow, so that they readily enter a nut, and can thus be used for internal work, and there is a stop which prevents the leaf opening beyond a line straight with the handle, this feature further facilitating its use for inside work. The larger pitches can be used as gauges to grind thread tools to. It is manufactured by the Standard Tool Co., Athol, Mass.

The Ordnance Bureau of the navy has completed requirements for the information of inventors who may desire to submit plans for the new submarine torpedo boat authorized by Congress. A boat will be called for with about 125 tons displacement. The motive power will be steam or electricity as the designer may select. The appropriation for the vessel is $200,000, of which about $50,000 will be retained for experimental purposes.

The April number of *The New York Standard* surpasses previous issues in some respects, one of the most notable of these being the publication, with portraits of writers, of a large number of contributions from celebrated men and women under the general heading "The Story of My First Watch."

The new cruiser, the "Detroit," on her recent trial in Long Island Sound attained an average speed of 18.7 knots and earned for her builders the handsome premium of about $170,000.

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Electricity and Manufacture.

A mechanical engineer of an observing turn of mind recently remarked that the small electric motor bid fair to revolutionize manufacture in many of its branches by placing men of small means more nearly on a level with those of large means, or great corporations or companies. And this, he reasoned, would result in improving the quality of things manufactured, and be in every way advantageous.

This may be a rosy view to take of the case, but there is considerable reason behind it. One of the greatest needs of the man working by himself, or in connection with two or three, or a half dozen others, is cheap motive power. He or they may require but little power, and that irregularly, but that little is wanted just as much as the large manufacturer wants a good deal. In this—the employment of motive power—the individual workman is, usually, at an enormous disadvantage as compared with the large manufacturer, with whom he must compete. This disadvantage begins with the first cost of motive plant, and follows all through its operations. The cost of engine and boiler, the space required for them, and the cost of fuel, water, attendance and repairs are enormously against the isolation of manufacture; they are all in favor of its centralization.

But with the small electric motor of satisfactory construction and operation, with this and electricity on tap, to use an expressive phrase, furnished at reasonable cost, this disadvantage would become strikingly less. With the ability to take power "into the back yard," and to pay for just what is used, the individual would be able to make a very satisfactory step towards the front; in some branches of the trades he might get quite to the front.

The individual, or the little band of two or three, would have one thing in his or their favor, and not a small thing in its operations, either. That is human nature. No man will work for another as well as he will for himself, or at least the exceptions to this rule are no more than sufficient to prove it. With average humanity the difference in this respect is greater than would generally be believed, that is to say, the difference in the results that obtain. It is greater than the most interested party—the individual workman—would believe, himself, until he had made the trial.

As to the quality of what is made to sell, the individual would see the absolute necessity of preserving that as he never—no matter how honest he might be—could see it when working for the large employer of labor. Working for himself he would realize that his chances of success, of gaining and preserving a reputation that should create and maintain a demand for what he made, depended upon himself alone. Working for others there is great likelihood that the habit, or practice, of thinking that one man cannot accomplish much anyway in keeping up the reputation of a great concern, or its solvency, as to that matter will take possession of the individual. Such plans as profit sharing and the like have their origin in the belief of employers of labor that something must be done to create an interest amongst workmen, and that the best way to do this is to convince them that, to a certain extent, they are working for themselves; that the right or the wrong doing of one is the concern of all. This plan has worked very well indeed, we believe, in some instances, but manifestly it cannot bring about the same results in the instance of almost any man that would be brought about by the feeling that he was working, individually, for himself. It would be necessary to reconstruct mankind before that would be the case.

After all, perhaps the engineer to whom reference has been made is not so far astray in his conclusions as to the possible influence of the electric motor on manufacturing as might appear at first thought. A good deal may—must—depend on the degree of perfection to which the distribution of power by the employment of electricity is brought.

The Belgian Workmen.

Some people who seem to have entirely forgotten the early history of this country and the principles set forth in the Declaration of Independence are condemning the Belgian workmen for resorting to violence to secure universal suffrage. The facts seem to be that there is no other way of securing what are undoubtedly the rights of the people. Every peaceable method of securing the desired reforms seems to have been exhausted, and the overwhelming vote against universal suffrage by a legislature elected by a vote restricted to about 2 per cent. of the population shows plainly that somebody must be forced, by violence if necessary, to do the right thing. In '76 we declared the right and duty of the people to do this very thing, and then went and did it. We can do no less than approve a similar action by another people. By refusing longer to carry on the work of society under hopelessly oppressive conditions, and by making demonstrations calculated to frighten the aristocracy of Belgium into a concession to democracy, the workmen of Belgium are proving themselves patriots, especially when in support of their principles they announce themselves as willing to and actually do sacrifice their lives. History will accord them an honorable place, and we shall hope for their success in establishing a representative government.

Since the above was written it is announced tnat the people of Belgium have triumphed so far as securing a vote for every man, though this is marred by giving a plural vote to property owners, which is unjust. This, however, may be righted by a majority vote, and if it cannot be, then another scare of the aristocracy may be necessary. Universal suffrage is a necessity for representative and just government. That secured, the further progress towards equal rights may be by peaceful educational methods.

Files and "File Steel."

The length of time which any cutting tool will continue to cut satisfactorily depends primarily upon the quality of the steel of which it is made. This is just as true of a file as of any other cutting tool, and one would think that it would pay to use a good quality of steel for files as well as for lathe tools or drills. But tons of the vilest steel that can be manufactured are used in the making of files, and "file steel" is a distinct brand of steel, so "cheap and nasty" that no one would think of using it for any other purpose—so cheap, in fact, that many of the best steel makers refuse to make it, and only supply steel to file makers who for some special files or for some special purposes want steel that is good enough to be used for other tools, and are willing to pay for it. There are a few brands of files which are known the world over as the best, and this is due largely to the fact that they are made of better steel than others. Stubs' files, for instance, are not excellent because they are English files, but because they are made of Stubs' steel, there being about as much difference between this steel for files and "file steel" as between a chestnut horse and a horse chestnut. Files are made both in England and in this country that will not compare very favorably with Stubs', mainly because they are made of "file steel," and, on the other hand, there are files made in both countries that will compare very favorably with Stubs', mainly because they are not made of "file steel."

There are too many buyers of files who choose them on a basis of discounts from lists, and consider scarcely anything else. Let such a buyer secure a specimen of regular "file steel," forge a lathe tool of it, and see how well it will stand when compared with a tool made of a good quality of steel. He will then have a pretty fair idea of how much better a file would be if made of good steel. Or, let him order a few files of a reliable maker, stipulating that they are to be made of some good quality of steel, pay the price for them, and then see what the result will be. But, if he does not choose to do this, then let him not compare the "file steel" files of one country with the special fine brands of another country, and say that the nationality of the file decides its quality. It is more a matter of price. In nearly every country where files are made at all, both good ones and poor ones are made, and a buyer can take his choice, but as a rule, only the better grades are exported, because freight charges and specific duties, if any, become too large a percentage of the total value.

Fore-warned, Fore-armed.

There will undoubtedly be a large crowd in New York to witness the naval demonstration, and another crowd on the day following to see the land parade which promises to be one of the most novel and interesting displays ever seen in this locality. Our railroads are well equipped for any emergency of transportation, and there is no reason why their patrons, however numerous they should be, should not be conveyed safely and quickly from and to their homes without subjecting them to any unnecessary hardships. It is to be hoped that the disgraceful mismanagement of some of the ferries during the Columbian celebration of last October will not be repeated this time. All the ferry companies have a sufficient number of boats to handle with dispatch any crowd that may come along, and give all a safe and comfortable conveyance across the river. If all these boats are put in service on the days of the celebration, and run under good and competent management, it may be reasonably expected that no one will be exposed to injury as was the case last October.

It is to be hoped that the managers will not forget their duty to their patrons and will show some regard for defenseless women and children, and will not trust to good luck or miracles to help them out of any difficulties into which they may be led if they persist in mismanagement.

The recent fire in Temple Court, this city, again illustrates the fact that it is vain to put too much faith in fire-proof buildings. In this case the building was badly injured by a fire which started on one of the upper floors, and there is little doubt but that if it had started on one of the lower floors the building would have been wrecked. Many of the occupants of the building had no fire-proof safes in which to keep their valuable books, records, etc., and the loss was therefore heavier than it would otherwise have been.

The A. S. M. E., and the engineering world generally, meets with a loss by the burning of records which were in possession of Mr. Gus. C. Henning, M. E, who is the working member of the society's committee on standard methods of testing. Practically all the data which had been gathered during the years this committee has been at work were destroyed, and such partial restoration as may be possible will involve a very great amount of labor and time in its accomplishment. In addition to this, Mr. Henning lost all his personal records of tests of materials, extending through a number of years, among them those made in connection with his work on the Henderson bridge over the Ohio. These are scarcely replaceable. They were very full and complete; from a small part of them the data for Mr. Henning's recent paper, "On the Elastic Curve and Treatment of Structural Steel," was derived; which paper *The Engineer*, of London, was kind enough to say comprised "about all that was known *in the States* regarding steel." The conclusion of the labors of the committee referred to above is, of course, indefinitely postponed by the fire, and a loss inflicted which will be very much regretted.

Mr. Deodatus Hilin Neale, one of the editors of the *Railroad Gazette*, died in Brooklyn, April 5, of spinal meningitis. Mr. Neale was an Englishman, and was connected with *The Engineer*, of London,

when he came to this country in 1883 to attend the Chicago Exhibition of Railway Appliances, since which time he has been connected with the *Railroad Gazette*, except during an interval when he was in Australia as Mechanical Engineer to the Railway Commissioners. Mr. Neale was a man of uncommonly fine abilities and attainments, and his death in the prime of life is a sad loss.

Literary Notes.

SWITCH LAYOUTS. Showing graphically the leads, offsets and all dimensions needed for locating frogs of all numbers and curves in all switches in common use. Curve easements, tables of angles, chords and deflections for easing the transition from a tangent of a curve, and from a curve of one radius to a curve of another radius. By Augustus Torrey, Principal Assistant Engineer, Michigan Central Railroad.

The title page of the book as stated above indicates clearly its character. The subjects are plainly stated in the explanatory introduction, and each of the 112 accompanying diagrams shows graphically and by figures the leads, offsets and all dimensions needed for laying out the switch or crossover indicated, as well as the list and dimensions of ties, head blocks, etc. These, in connection with the numerous tables, make the book an exceedingly valuable one to the section foreman, as it will enable him to have the work properly done with but little instruction and direction from the engineer. It is a time-saving manual, and we know of no other work treating on this subject which is as practical and complete as this one.

It is published by the Railroad Gazette, 73 Broadway, New York. Price, $1.00.

QUESTIONS AND ANSWERS.

Questions of general interest relating to subjects discussed in our columns will receive attention in this department. The writer's name and address should always accompany the question. Neither correct initials nor location will be published when there is a request to that effect. If questions are enclosed with a business communication, they should be written on a separate sheet.

(204) W. T. S., Providence, R. I., writes: Please inform me in what issues of the AMERICAN MACHINIST I will find how to lay out a locomotive valve gear. *A.*—May 10, 17, 24 and 31, 1884.

(205) M. B., Fincastle, Va., writes: Please give me a description of a device for turning wrist pins cast to crossheads such as cannot be turned in a common lathe. *A.*—You will find an illustration and description of a very good lathe attachment for this purpose in our issue of April 14, 1888.

(206) W. S. H., Beaver Meadow, Pa., asks: Where could I obtain a catalogue for nickel-plating apparatuses? *A.*—Write to the Gorham Mfg. Co., Providence, R. I., for one of their little books treating on the source and nature of electricity and its application to the electro plating process.

(207) J. E. F., New York, writes: Please inform me where I can find the most information relating to rotary engines, either in books or papers. *A.*—There is but very little to be said about rotary engines. Appleton's Cyclopedia of Applied Mechanics probably contains as much useful information on this subject as any other book. This work you may find in nearly all the good libraries in the city.

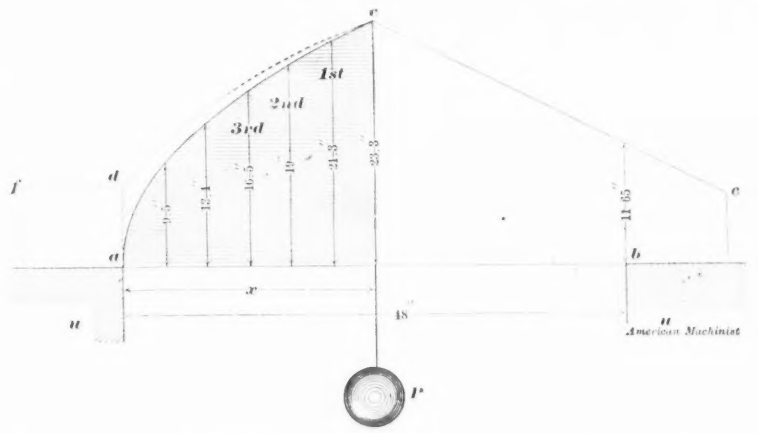
(208) F. W. B., Lynn, Mass., writes: I understand that reports are issued by the bureaus of the army and navy departments at Washington which are of considerable value to the mechanical engineer. Please inform me how they can be obtained. *A.*—Ask the congressman of your district to obtain them for you; it is doubtful if you can obtain them in any other way.

(209) C. W., New York, asks; Is it possible to obtain a good text-book on perspective drawing and line shading? If so, please give title and place where the same may be obtained. *A.*—We believe that Davies' shades and shadows and perspective will suit you; it is one of the best text-books on these subjects. It can be obtained from any dealer in scientific works or dealer in school books.

(210) J. J. C., Dublin, Ga., asks: Can brass or any hard alloy be cast in plaster-of-paris, and if so, how can it be done? *A.*—Hard alloys can be cast in plaster-of-paris molds. The mode of procedure is the same as that of ordinary molding in the foundry, with the exception that the mold is composed of a mixture of one-third of plaster-of-paris and two-thirds of fine brick dust made to the right consistency with water; the mold must be thoroughly dried. 2. How many casts can I get of one mold? *A.*—One.

(211) E. P. P., Dickey, Ga., writes: I have a copper boiler to patch which is about ¼ inch thick, used in a turpentine distillery. Could I use iron for the patch, or is it necessary to use copper, and how thick should that be? *A.*—Do not use iron; use copper fully as thick as that in the boiler, or say ⅜ inch thick. 2. Please give me the kind, size of rivets and distance between them. *A.*—Copper rivets ¼ inch diameter; pitch ⅞ inch. 3. I have a shaft 75 feet long, 3 inches diameter, which I wish to put on a brick foundation. Please give me the proper method of doing the same with number of brick pillars and the size of the same. *A.*—You will need 7 pillars making the distance about 9 feet between the centers of bearings. The size of pillars will depend on the ground on which they are placed, and on work the shaft has do. 4. Will it be injurious to burn fat pine in a vertical boiler? *A.*—With judicious firing no injury will result.

(212) E. S. A., West Bay City, Mich., writes: Please state which is the best position for the cranks of a triple-expansion engine, and give reasons. Several builders on the lakes place the cranks in the following order—high pressure, low pressure, and then intermediate pressure, while others adopt the order of low pressure, intermediate, and then high pressure. *A.*—The position of the cylinders depends much on the general design of the engine. The aim is to make the whole as compact and convenient as possible. The natural position of cylinders in a triple-expansion engine is, high pressure, intermediate, and then low-pressure cylinder. If the steam chest is placed at the front or back of the engine, the cylinders may be placed much closer together, and a very symmetrical arrangement is got by placing the low-pressure cylinder in the middle, while a little less space still is occupied by putting the high-pressure cylinder in the middle.



(213) T. A. W., Taunton, Mass., asks: Which is the tallest chimney in the world? My friend says a chimney in Fall River is the tallest one. I say not. Also name the five highest chimneys. *A.*—The chimney at Townsend's works at Glasgow, Scotland, is 454 feet high; this is the height of the brick-work. To this was added a copper extension, making the entire height 488 feet. The next highest is at Tennant & Co., also in Glasgow; it is 435 feet high. The third is at Dobson & Barlow, Bolton, England; it is 367 feet high. The next is in Boston, built for the Fall River Iron Co.; it is 350 feet high. Then comes the chimney built for the Clark Thread Works at Harrison, N. J.; it is 335 feet high. It should be observed that the first three chimneys mentioned were not designed primarily for draught of boilers, but are used in connection with chemical works, where high shafts are essential to carry noxious gases and odors off without endangering public health. For further information on this subject see AMERICAN MACHINIST, June 19, 1890. 2. Which is the hardest boat to row, a flat or round-bottom boat? *A.*—This is simply a matter of model; on general principles the round-bottom boat is easier to row than the flat one, but it is possible to construct a flat-bottom boat which can be rowed in smooth water as easy as the other. 3. Which of the two above-mentioned boats is the hardest one to tip? *A.*—The flat-bottom boat. 4. A retired engineer says he used an inspirator for feeding a boiler, and that the feed water on entering the boiler was cold. I would like you to explain how this can be so. *A.*—If the engineer says that the feed water in entering the boiler was as cold as the supply, you can tell him that he is mistaken.

(214) E. M. C., Berlin Falls, N. H., writes: I wish to build a small cylinder, say, 4 to 7 inches diameter, to withstand 4,000 to 7,000 pounds pressure per square inch. Had I better use cast-iron, brass or steel? Also how can I find the thickness of cylinder when made of any one of these metals? *A.*—The choice of metal depends on kind of work the cylinder has to do. The thickness of cylinder can be found by the following formula:

$$t = \frac{p \times r}{s - p}$$

in which s denotes the tensile strength of the metal per square inch; p, the internal pressure in pounds per square inch; r, the inner radius in inches, and t, the thickness in inches. In ordinary language the formula reads: Multiply the internal pressure per square inch by the radius in inches, call this product A. Subtract the internal pressure per square inch from the tensile strength per square inch giving a remainder B; divide product A by the remainder B, the quotient will be the thickness in inches. If, for instance, the cylinder is to be 7 inches diameter, the internal pressure 7,000 pounds per square inch, and the cylinder is to be made of cast-iron, for which the safe tensile strength is, say, 10,000 pounds per square inch, we then have,

$$t = \frac{7{,}000 \times 3.5}{10{,}000 - 7{,}000} = 8.16 \text{ inches.}$$

2. I wish to build a beam of cast iron 2 inches thick, to be supported at both ends and loaded in the middle with about 50 tons; the distance between supports is to be 4 feet. How deep will this beam have to be in the middle and at the ends so that each part of it will just carry its load, and be as likely to break at one place as another? *A.*—Let the shaded portion of the figure represent one-half a beam supported at each end and loaded at the middle. If the bottom edge of the beam is straight, the upper edge of the shaded portion will be a parabola with its vertex on the edge a of the support u, and its axis on the line $a\ b$. The other half of the beam will, of course, be bounded by a similar curve. To find this curve we must compute the depth of the beam at various sections from the center. Divide one-half the length of the beam into, say, six equal parts and through each point of division draw a vertical line, these lines will then be 4 inches apart, and each will represent a plane cutting the beam, thus giving us six different sections, one of them being in the middle of the beam. In computing the height of each section we shall always denote the distance in inches from the edge a of the support to any of the sections by x, the load we shall denote by P, the breadth in inches by b, the depth in inches by d, and the safe stress in the outer fibers by S, for which we shall take value of 6,600 pounds (cast iron). Now for computing the depth d of each section or ordinate we use the following formula,

$$d = \sqrt{\frac{3 \times P}{S \times b}} \times x.$$

For the middle section, x is equal to 24 inches; substituting for the symbols their values we have,

$$d = \sqrt{\frac{3 \times 100{,}000}{6{,}600 \times 2}} \times 24 = 23.3 \text{ inches.}$$

The value of $\frac{3 \times P}{S \times b} = 22.727$, remains constant for computing the depth of all the sections, but the value of x changes for each section. For the first section from the center the value of x will be 20 inches, hence the depth of this section will be,

$$d = \sqrt{22.727 \times 20} = 21.3 \text{ inches.}$$

For the second section we have,

$$d = \sqrt{22.727 \times 16} = 19 \text{ inches.}$$

For the third section we have,

$$d = \sqrt{22.727 \times 12} = 16.5 \text{ inches.}$$

In a similar way the depth of any other section is found. These depths are now laid off from the line $a\ b$ on the correspondent ordinates, and a curve is drawn through their upper extremities, which will be the required parabola. Here we have allowed nothing for the vertical shear, which when taken into account will slightly change the curve. The section at $a\ d$ to resist the shear is found by the formula $\frac{1}{2}\frac{P}{s}$ in which P denotes the load as before, and s the safe shearing strength per square inch; let the value of the latter be 3,400 pounds, we then require a section at $a\ d$ equal to

$$\frac{\frac{1}{2} \times 100{,}000}{3{,}400} = 14.7 \text{ square inches,}$$

the breadth is 2 inches, hence the depth at $a\ d$ will be,

$$\frac{14.7}{2} = 7.35 \text{ inches,}$$

and the curve should be raised to the point d, and drawn to c as shown. From d to f, the amount that the beam projects over the edge of the supports may be made of uniform depth. The practical way of constructing the beam is to make the depth at $a\ d$ equal to half the depth at the center, as shown at b at the right-hand support, and then join the extremity of this ordinate and the point c by a straight line and produce it to e the end of the beam. This beam will, of course, be a little stronger at b than at the center, but the metal wasted will not cost as much as the labor required to curve it as shown at the left-hand side.

BUSINESS SPECIALS

Transient Advertisements 50 cents a line for each insertion under this head. About seven words make a line. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue.

Grant Gears. Lexington and Phila. See page 11.

Shafting Straighteners. J. H. Wells, Tampa, Fla.

Ideal Drawing Stands. M. C. Hammett, Troy, N. Y.

Forming Lathes Mer. Mach Tool Co., Meriden, Ct.

Air Hoists, Frank Richards, Box 3686, N. Y.

6 Spindle Turret Drills A. O. Quint, Hartford, Ct.

"Bradley's Power Hammers, the best in the world." 20 sizes. Bradley & Co., Syracuse, N. Y.

Pattern and Brand Letters. A variety of sizes and styles. Heber Wells, 8 Spruce St., New York.

Drill Presses, with Tapping Attachments.
Gould & Eberhardt, Newark, N. J.

Davis Key-Seating Machines kept in stock by Manning, Maxwell & Moore, 111 Liberty St., N. Y.

Selden Packing for stuffing box, with or without rubber core Randolph Brandt, 38 Cortlandt St., N Y.

Pulley lathes, most efficient offered. The Lodge & Shipley Machine Tool Co., Cincinnati, O.

Engine Castings, Humphrey's Foundry, Bellefontaine, O.

Air Compressors for every possible duty Clayton Air Compressor Works, 43 Dey Street, N. Y.

For Cypress Tanks and Vats, address W. E. Caldwell Co., Floyd and Main Streets, Louisville, Ky.

Factory sites given away, 1 hour from New York. Address R. V. Pierce, Bound Brook, N. J.

Guild & Garrison, Brooklyn, N. Y., manufacture steam pumps, vacuum pumps, vacuum apparatus, air pumps, acid blowers, filter press pumps, etc.

"Shapers (Double Triple Quick Stroke")
Trade Mark.
Gould & Eberhardt Newark, N. J.

Split Pulleys at low prices, and of same strength and appearance as Whole Pulleys. Yocum & Son's Shafting Works, Drinker St., Philadelphia, Pa.

For best Return Steam Traps, Pressure Regulators, Positive-Acting Pump Govs., Back-Pressure Valves. T. Kieley, 11 W. 13th St., N.Y. Send for des'n.

For the Latest Improved Diamond Prospecting Drill, address the M C. Bullock Mfg. Co., corner Canal and Washington Sts., Chicago, Ill.

Combination, duplex and special gear cutters in stock and to order. vertical milling machines. R. M. Clough, Tolland, Conn.

"Pumping Machinery." New book, 450 pp. 8vo, 270 Eng. Prospectus free. W. M. Barr, 3223 Powelton Avenue, Philadelphia, Pa.

Gear Cutters, Auto. Specially adapted for Motor Gears and all other style Gears.
Gould & Eberhardt, Newark, N. J.

Patent Soliciting of High Class.
D. Walter Brown, Counsel in Patent Cases,
31 Nassau Street, New York.
Send for Brief History of Patent Legislation.

De Lamater Screw Propeller Wheel, made only by The Samuel L. Moore & Sons Co., Elizabethport, N. J., who have purchased from C. H. De Lamater & Co., New York, all their patterns, books of record, gauges, etc. Location and equipment well adapted for Heavy Steamship Repairs.

"Binders" for the AMERICAN MACHINIST. Two styles—the "Common Sense," as heretofore sold by us, and mailed to any address at $1.00 each, and the "New Handy," mailed at 50c. each. The former has stiff board covers, while the latter has flexible covers with full page opening flat. Either will hold the entire 52 issues of any volume. AMERICAN MACHINIST PUBLISHING CO., 203 Broadway, New York.

"Indicator Practice and Steam Engine Economy." By F. F. Hemenway. Contains plain directions for using the indicator and making all required calculations from the diagram, also the principles of economy in operating steam engines and current practice in testing engines and boilers. Price, $2 postpaid. Published by John Wiley & Sons, 53 East Tenth Street, New York.

Coe Brass Manufacturing Company.

Continued from page 4.

with a mixture of sand and other things to form the core, and is smoothed, trued and packed firmly by the workman who uses tools for this purpose that are very simple and work much upon the principle of the plasterer's trowels, only these are trough-shaped and are applied while the core is revolved. After this the core is thoroughly dried in a special oven, in which it is kept until within a very few minutes of the time it is to be

set in the mold and the brass poured. If removed from the oven for any considerable time before this, it is liable to absorb from the atmosphere some moisture which would be very apt to render the cast worthless. After this casting has been thoroughly cleaned inside, the drawing operation, by which it is reduced to accurate dimensions inside and out, and given the fine finish so much admired on this kind of tubing, begins. This is done in this mill by hydraulic machinery of the most elaborate description, the plant for this having been designed by and built under the supervison of the master mechanic, Mr. John F. Ellis.

One end of the rough tube is swaged down in dies and a very smooth and well finished steel plunger or arbor, which is first thoroughly lubricated, is pushed into it; this being, however, somewhat smaller than the cored hole in the casting. The swaging at the end allows the end of the tube to pass through the drawing die and at the same time prevents the end of the arbor from being forced out at the end. The tube and arbor being then supported in a horizontal position are forced together through the die, the pressure being applied to the arbor, and the outside of the tube being also thoroughly lubricated. The reduction is sufficient to close the tube very tightly upon the arbor, and after the end of the tube has passed through the die it is blocked so that it cannot return and the arbor is pulled out, this latter operation requiring far the more force, since the static friction throughout its whole length, which may be 10 feet, has to be overcome at starting.

The power required for this is furnished by hydraulic cylinders about 25 feet long, which are parts of the draw-benches, and are placed horizontally in line with the die holder. A workman who stands near the die starts, stops or reverses the motion by the slight movement of a lever, while others manipulate the work, place and remove the dies, attend to the lubrication, etc., the work going on with the regularity of clock work, except when, as sometimes happens, and did happen while I was watching the operation of one of the machines, the arbor is forced through the end of the tube where it has been swaged down, bursting it; this, however, does not often occur.

Toward the end of the operation the process is varied by inserting in the tube a hardened and ground steel arbor which is full size for a short distance at the end only, the rest of its length being small enough to clear the tube, and long enough to pass out and be fastened to a part of the machine opposite the drawing die. The swaged end of the tube is then passed through the die, bringing the part of the arbor which is full size just within the die, when tongs hitched to the end of the tube and drawn back, pull the tube through the die, which is thus provided with a stationary core, and one motion completes the draw instead of two being required as in the former operation, and also giving the inside of the tube a high finish.

There are eight of these hydraulic draw-benches; two of them being used on work which varies greatly in the amount of the power required are driven directly from pumps so that the water is supplied to them at no greater pressure than is required to overcome the resistance, while the others, doing work which is more uniform, are driven from an accumulator which is in a separate room provided for it, and is a remarkable structure. It consists of an upright cylinder which rests upon a stone foundation and is 25 feet high with walls thick enough to stand a pressure of 1,000 pounds to the square inch. To this cylinder is fitted a ram which is 16 inches diameter and 20 feet stroke, and packed with the ordinary hydraulic packing. Attached to the top of the ram is a circular plate having cross ribs from which are suspended the rods that hold the mass of iron with which the ram is loaded, this being made of segments of a circle which, when in place, encircle the cylinder outside, clearing it sufficiently to allow of free movement. The weight of the ram and its load for the working pressure used, 500 pounds, must, of course, in this case amount to about 100,500 pounds. A number of very powerful pumps which are ranged along side by side in the basement, and driven from a shaft by gearing, pump into the system of pipes of which this accumulator forms a part, while from the same system the supply of water for six of the tube draw-benches, before referred to, is drawn The pumps are in motion all the time, but an automatic device controlled by the accumulator ram holds certain valves off their seats when a sufficient amount of water to raise it to its full height is in the system, and the water in the pump then goes through a by-pass and circulates under nominal pressure. If the draw-benches use the water faster than it is being pumped the weights attached to the ram move downwards; when it is being pumped faster than used the weights rise, the pressure remaining practically constant. A more efficient plant for the purpose would be very hard to imagine, and it certainly reflects great credit upon its designer and builder as well as upon the concern that had sufficient enterprise and business sagacity to invest in it to the amount of its necessarily great cost.

An interesting instance of the composition of forces is seen here when Mr. Ellis by applying his hands to the ring of 100,000 pound weights encircling the accumulator cylinder easily sets them rotating rapidly around it, carrying with them the ram and all its appurtenances. Of course, the friction in this case is relatively very small, for the weight is supported upon water, the friction of which is independent of pressure, and the greater part of the frictional resistance is in the hydraulic packing at the top of the cylinder.

Large amounts of brass, copper and German silver wire are made here, a considerable portion of the machinery used in this having been developed in the works, by Mr. Ellis and others. The larger gauges of wire are drawn through steel or cast chilled dies, while the smallest gauges are drawn through diamond dies which are drilled for the purpose. Copper wire is made for electrical and other purposes which is 40 B. & S. gauge or .003144-inch diameter.

A good deal of the sheet brass is cut into narrow strips by shears which are nothing more than disks of hardened steel put onto arbors with washers between them of the proper thickness for the required spacing on the arbor. Both edges of these disks cut, and as many as twelve of them are placed upon a single arbor, which with their washers make 23 pieces upon each of two arbors that must be ground so accurately as to thickness that the disks on either arbor will enter and fit the spaces on the other, which it will be seen they would come nowhere near doing if each varied in thickness as much as .00025-inch.

Another job which shows how fine the work may be required to be is seen in the case of the strips of copper which are drawn for commutator bars. These strips are a segment of a circle in section and in one case, at least, the requirement is that 120 of them cut from the same bar when placed together inside a hardened and ground ring shall just fill it closely, and I saw a ring about 5 inches diameter thus filled. It is readily seen that a very small variation in size will make the last strip either refuse to go in or be too loose. Since, when these strips are in the commutator, they are separated from each other by insulating material, it is hard to see why the limit of variation should be so close. Perhaps those who require it do not appreciate what it costs to do such drawing, but so long as they pay for it, it is presumably not to be found fault with.

Of course considerable machine work is required in such an establishment for making special machinery, dies, etc., and there is therefore a well-equipped machine shop in which a good deal of high-grade work is done. Connected with this is also a very well-arranged and fitted blacksmith shop.

A large amount of copper, brass and other alloys are worked daily here, and it is evidently done in the most systematic and best possible manner, the methodical, cleanly, neat and orderly appearance of all parts of the establishment evidencing the best of management. F. J. M.

A Correction.

In our issue of April 20 we illustrated some hydraulic riveting machinery for the Niles Tool Works. In connection with this illustration we should have said that these machines were made by the Morgan Engineering Company, of Alliance, Ohio, and were sold by the Niles Tool Works Company, 138 Liberty street, New York.

MANUFACTURES

There is talk of a plan for locating a shoe factory at Tionesta, Pa.

Work has commenced on the Angleton (Tex.) canning factory.

Work on the Victoria (Tex.) water-works system has commenced.

A steam mill is to be erected at Mexico, near Rumford Falls, Me.

The Superior Block Coal Company, of Brazil, Ind., has been organized.

A new foundry will be erected at Petersburgh, Va., by Norfolk capitalists.

The Andrews Wire Works of Rockford, Ill., are to rebuild on a larger scale.

The Zaleski Coal Company is reported as about to sink a shaft at Marshfield, O.

It is stated that George West will build an addition to his mill at Luzerne, N. Y.

The Derwent Stove Foundry Co., at Ellwood City, Pa., is to erect an addition.

It is stated that the Lindner Shoe Co., of Carlisle, Pa., has increased its capital stock.

An irrigation company with $600,000 capital has been organized at Brownsville, Tex.

The Detroit (Mich.) Foundry Equipment Co. will erect two buildings, 90x175 feet.

The Georgia Central Railroad Company intends to erect car shops at Cedartown, Ga

The National Wire and Iron Company, of Cleveland, O., will erect an addition to its plant.

The Gaffney (S. C.) Manufacturing Co. has doubled its capital stock, making it $200,000.

At Lynn, Mass., the new steel foundry at the Thomson-Houston works is about completed.

The Caucus Manufacturing Co., of Philadelphia, Pa., has been incorporated with $26,000 capital.

Simpson, Hartwell & Stopple will erect a new foundry and machine shop plant at Houston, Tex.

The Ruthford (N. C.) Cotton-mill has been capitalized to erect a plant. J. C. Cowan is president.

The Illinois Nail Company, of Chicago, Ill., has increased its capital stock from $50,000 to $100,000.

The Richards Paper Company will soon begin the rebuilding of its burned paper mill at Gardiner, Me.

The new roller-mill at Burnet, Tex., has been completed, and the machinery is being placed in position.

Caleb Calvin is to build a brick addition to his foundry at Worcester, Mass., 40x40 feet, one story high.

Messrs. Bullard, Thorp and Wagman are talking of building a pulp-mill at Fort Miller, N. Y., in the spring.

The Enoree (S. C.) Manufacturing Co. will enlarge the capacity of its mills and put in new machinery.

The Menomonie (Wis.) Manufacturing Company has been chartered with $5,000 to operate a foundry.

An addition will be built on the plant of the Ellwood Gas Stove and Stamping Co., at Ellwood City, Pa.

Dayton, Ohio, is to have a new paper-mill. It is stated that writing paper is to be the output of the mill.

A concern will be formed with a capital of $50,000 for the manufacture of paper at Westbrook, Me.

A company to erect a cotton factory at Petersburg, S. C., has been organized, with a capital of $50,000.

The Manufacturers' Investment Company is to make an addition to the big sulphite pulp mill at Madison, Me.

M. T. C. Jordan, J. A. Watts and others are establishing a company to start a shirt factory at Roanoke, Va.

The Veness Machine Company has been organized at Pittsburgh, Pa., with capital $10,000, by A. E. Veness.

An addition is being erected to the foundry of the Diamond State Car Spring Company at Wilmington, Del.

Another knitting-mill will be established in Anniston, Ala., under the management of Mr. Gabe Lippman.

The Foster Boiler Furnace and Manufacturing Co., of St. Louis, Mo., has been incorporated, capital, $50,000.

The J. V. Abbott Manufacturing Co. is erecting a 34-foot addition to its loom picker works at East Dedham, Mass.

Jas. Curran and others have incorporated the Curran Manufacturing Company, at New York. Capital, $100,000.

The directors of the Utica (N. Y.) Paper Novelty Company will increase the capital stock from $3,500 to $10,000.

Geo D. Wadley and others have incorporated the Wadley Continuous Draw Bar Co. The capital stock is $100,000.

The Koken Iron Works, of St. Louis, Mo., have filed articles to increase their capital stock from $100,000 to $200,000.

John F. Stevens, proprietor of the Enterprise Boiler Works, Indianapolis, Ind., is building an addition 60x40 feet.

The shoe factory of G. W. Bailey at Scituate, Mass., has been leased by C. Drolet, who will operate it and enlarge.

It is stated that despite all the talk to the contrary, the Pepperell Co. will erect a new cotton-mill at Biddeford, Me.

It is announced that the Chicago packing firm of Swift & Co. had increased its capital stock from $7,500,000 to $15,000,000.

The C. D. Morse Manufacturing Company, of Millbury, Mass., will erect a plant for the manufacture of electric cars.

A concern to be known as the Mayhew Compo-Board Co. has been incorporated at Lewiston, Me., with a capital of $1,000,000.

A stock company is to be organized at Lynn, Mass., by N. Y. Ober and others, to manufacture a machine for paving streets.

There is water-works agitation at Dartmouth, N. S.; Chanute, Kan.; Methuen, Mass; Lancaster, O.; Galveston, Tex; Petersburg, Va.

A. Nute & Sons' Shoe Co., of Farmington, N. H., capital $25,000, is the latest corporation to file articles with the Secretary of State.

W. W. Fogg & Co., Bangor, Me., will engage in hat manufacture in connection with their new clothing factory in Exchange street.

President Fitzgerald and Superintendent Roberts of the Riverside Cotton-mills, at Danville, Va., will double the capacity of the plant.

Wm. R. Renwick and Emmet E. Dietrich, of Grand Rapids, Mich., will establish a spoke and stave factory at Houston Heights, Tex.

E Kibler is organizing a company at Newark, O., to establish a plant for making twine and cordage, with a capital stock of $50,000.

A. B. Clark, Peabody, Mass., is about to make an addition to his factory, 240x40 feet, six stories, so as to make the output 100 dozen skins a day.

The Newport (Va.) News & Hampton Soap Manufacturing Co. has been organized, and will start a soap factory and steam dyeing and scouring plant.

The Finch Manufacturing Co., of Scranton, Pa., with a capital of $250,000, has been organized. The incorporators are Irving A. Finch and W. I. Finch.

The People's Tanning and Manufacturing Association has been organized at Cumberland, Miss. O. C. Davis is president and the capital stock is $50,000.

The Boston Harness Co. has been organized at Portland, Me., for the purpose of manufacturing all kinds of harness and saddlers' goods, with $300,000.

The American Rattan and Reed Manufacturing Co., of Brooklyn, N. Y., has been organized, capital, $50,000. C. H. Lewis, David May and others are interested.

There is a prospect that the projected cotton-mill at Oldtown, Me., and other plans for development by the Bodwell Water-power Company will materialize this season.

The Elitsac Manufacturing Co. has been organized at Castili, N. Y., to manufacture novelties and articles of wood. Capital, $16,000, and directors, J. S. Chapman and others.

The Patchogue Paper-mill, Patchogue, N. Y., has been reconstructed from the foundation. Nearly all the old buildings have been taken down, and a new two-story mill has been built.

Bennetsville, La., is to have a large tanning factory. Mr. George Bennett has set the work in motion. Preparations are being made for putting up the buildings, vats and machinery.

Work is about to begin on an addition to the plant of the William Skinner Manufacturing Co., Holyoke, Mass. The new building will be of brick, and will be five stories high and about 100 feet long.

The Ohio Steel Company, Youngstown, O., by act of the legislature on March 31st, increased their capital stock from $750,000 to $1,000,000. The mammoth plant is being erected as fast as possible.

A typewriter makers' combination, with a capital of $20,000,000, has been formed and incorporated in New Jersey. The companies interested

are the Remington, Yost, Hammond, Caligraph and American.

The Glendale Elastic Fabric Co., of Easthampton, Mass., owing to its largely increased business, is adding to its plant a considerable quantity of flat running machinery, for the manufacture of elastic goring.

The Victor Coal and Coke Company has field articles of incorporation in Denver, Col. The capital stock is placed at $1,000,000, and the directors named are D. A. Chappel, S. S. Murphy, John Cameron and C. Yeaman.

The Sanitary Germ Proof Filter Co. has incorporated in San Francisco, Cal., with $100,000 capital and $44,000 subscribed. Among the directors are: De Witt C. Gray, Henry L. Davis, J. W. Beatty and P. L. Koscialowiski.

The Curtis Regulator Company, Boston, Mass., has consolidated with the D'Este & Seely Co., in whose name the business will hereafter be conducted. This will give increased capital and other facilities for carrying on the business.

Crane Bros., of Westfield, Mass, manufacturers of paper, have erected a three-story brick addition, having largely increased their plant They have recently commenced the manufacture of canoes and boats constructed entirely of paper.

The Atlantic Improvement Co., of Long Island City, Long Island, N. Y., have placed the contract for their new power station, consisting of an engine and boiler house and dynamo room, with the Perlin Iron Bridge Co., of East Berlin, Conn.

The Slater Engine Company have let the contract to erect their shop at Warren, Mass., to John R. Hosmer of this city. The main building is to be 250x60 feet, one story, with monitor roof. The contract also includes the erection of a foundry.

Murdock & Freeman, bottlers, Portland, Me., are enlarging their quarters to double their present capacity. They have lately added a new boiler and a 25 H. P. engine, also new and improved machinery for the manufacture of light summer drinks.

The Youngstown (Ohio) Tin Co. is remodeling the old malleable iron works into a tin plant. The capacity will be 35 boxes of bright and 80 boxes of terne every 24 hours. The majority of the stockholders are old workmen of the N. & G. Taylor Co., of Philadelphia.

Articles of incorporation were filed recently by the Fuller Coal and Mining Company. The stock is $50,000, and the stockholders are as follows: Geo. P. Fuller, Chas. D. Fuller, Frank D. Fuller, Fred. A. Fuller. The amount paid in is $6,000. The company intends to do business at Pedro, Barton County, Missouri.

The Mountain City Woolen-mills, of McMinnieville, Tenn., manufacturers of jeans and linseys, will erect a large brick building 40x100 feet, to make room for their growing business, and will put in new wool-washing machines, new mule spinning frames, new metallic breast in cards, and possibly new burring machines.

The Webster & Perks Tool Co., of Springfield, Ohio, have issued a small pamphlet which is devoted to a description and illustration of their reducing motion for indicating steam engines. In the pamphlet are incorporated a number of very flattering commendations of the device from very well-known engineers who have used it.

The E. C. Morris Safe Company are erecting a large works at Readville, Mass. About 300 men will be given employment. The works will comprise six large one-story brick buildings, which will cover over two acres of ground. The company have a capital of $250,000.

J. J. McCabe is removing to 14 Dey street, for the purpose of securing increased facilities and larger show-rooms. He will carry a stock of tools from the following firms which he represents: Fitchburg Machine Works, Powell Planer Company' Prentice Bros, Hendey Machine Co., and other new improved tools. He will also carry a large stock of second-hand tools.

The Batavia Preserving Company, comprising the canning factories at Middleport, N. Y., Batavia, N. Y., and Spencerport, N. Y., will increase its capital stock from $50,000 to $100,000. A dividend of 9 per cent. was declared at the annual meeting recently. Extensive improvements are being made in all three factories. C. H. Francis will be general manager the coming year.

Plans have been completed for the formation of a new paper-making company at Windsor Locks, Conn. It will be called the Anchor Paper-mills Co. The product will be specialties in tissue papers. The capacity of the plant will be from three to five tons per day, and it will be under the management of Mr. Pusey of the Coogan & Pusey Company. The capital stock of the company is $150,000.

In West Medway, Mass., the U. S. Linen Co., of Maine, has purchased the Campbell Paper-mill privilege, and will at once commence the erection of suitable buildings for manufacturing purposes. They will utilize the fiber of flax which is now wasted, and by a new process at small cost will make this waste material into a lint for mixing with wool and cotton. Some 50 men will be employed.

The General Electric Company is to build a large electrical works a short distance from the city limits of Akron, O. This will bring them much nearer their base of supplies, and will be a great saving in freight. Options have been secured on ground, and a belt line railroad will be built to connect the plant with the neighboring railroads. It is understood that nearly 700 men will be employed in the works.

Hollweg & Reese are making improvements to their glass works in Greenfield, Ind. They are using natural gas to a great advantage at these works, a Knickerbocker regulator, three tons capacity, regulating the supply. The Knickerbocker Gas Regulator Company is also putting in a regulating station at the Premier Steel Works, one of the largest they have ever constructed. It is to regulate the supply of gas under thirty boilers.

A. B. Farquhar Co., Limited, York, Pa., has issued an advance circular of the von Mengeringhausen automatic Corliss engine. The inventor writes: "We are getting right into it, so to speak, with this engine; we are now building a 24"x36" and a 20"x30"; expect two more orders this week, one (second) 24"x36" and 12"x30" (third); sent a 12"x30" to Chicago to the World's Fair last Friday, but am sorry we were too late to put it on a good foundation; as it is, I have made a wooden foundation of 12"x12" and 12"x6" timber to be imbedded in concrete underneath the floor; the flooring will be put on top of these timbers, and engine is to be bolted down to the floor, the bolts passing through floor and timber. I think this will answer to run the engine with a brake on band wheel. Prospects are very good with us, and we have already considered the building of a large new machine shop and boiler shop, as our present capacity is considerably too small for our orders. I think the firm's consideration will develop into a definite shape very soon."

Machinists' Supplies and Iron.

New York, April 19, 1893.

Iron—American Pig—We quote Standard Northern brands, No. 1 Foundry, $14.50 to $15.25; No. 2, $13.50 to $14.25; Gray Forge, $12 75 to $13 50. Southern brands of good quality are obtainable at $14.25 to $14.75 for No. 1 Foundry; $13.25 to $14 for No 2, and $12.25 to $13 for Gray Forge.

Antimony—The market is steady. We quote L. X., 10¼c. to 10½c.; Cookson's, 10½c. to 10¾c.; Hallett's, 10.10c. to 10.20c., and U. S. French Star, 10½c.

Copper—The market is dull, although prices seem to be firmer at 11⅛c. for Lake Copper on spot. Casting Copper is held at 10¼c. to 10⅝c.

Lead—The market is favorable to holders who are now asking 4.20c. as the inside price.

Lard Oil—Prime City is quoted at 84c. to 85c.

Spelter—The market is firm, and offerings are light. Sellers have advanced their price to 4⅛c. for New York delivery.

Tin—The market is dull. Previous rates are quoted; offerings of April delivery are made at 20.85c., May at 20.95c., and June at 21.05c.

✻WANTED✻

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Wanted—Salesmen on commission, to push a special line of mach'y. "Kirk," care of Am Mach

Wanted—Foremanship; engines, pumps or general jobbing. Indicator, American Machinist.

Designer & dftsman, 8 years' prac. exp., wishes a change; tools & special mach'y. Box 98, Am. Mach

Wanted—Situation by mech. draftsman, six years' experience on machine tools and special machinery. Good ref. Box 87, Am. Machinist.

Wanted—Pattern makers on heavy machinery work. None but 1st class workmen of good habits need apply. Farrel F'd'y & Mach. Co., Ansonia, Ct.

Wanted—Position by a machinist of steady habits, used to light, close work on machine or vise. G. A. Replogle, 2240 Adams St., St. Louis, Mo.

Foreman in iron foundry, all kinds of light or heavy gray iron castings, green or dry sand; best of references. Box 100, American Machinist.

Wanted—An experienced and competent man as sup't in forging department of a carriage hardware manufactory. Manufacturer, Box 58, Am. Mach.

Wanted—Position by mechanical draftsman, with college education and 3 years' experience in drawing room. "Norwegian," American Machinist.

Mechanical draftsman wishes position on steam engines and machines in general. F. F. Kirpal, 128 W. 61st St, New York.

A practical man in mech. shop and foundry, can mix iron on analysis, wants position as supt.; can give best of refs., will guarantee to save salary on the mixture of iron alone. Box 79, Am. Mach.

Wanted—Smart American blacksmith, to do tool and light work, and take charge small forge shop; good position for the right man. American Projectile Co., Lynn, Mass.

Foreman blacksmith desires change position; thoroughly posted in most modern methods and machinery; knows how to handle men; sober, and a hustler. Address J. G., American Machinist.

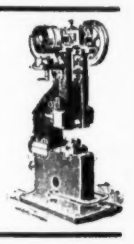
Wanted—A young man, graduate of College or Manual Training School, who has had a little shop and drafting office experience. Address Box 99, American Machinist.

Wanted—By competent man, position as foreman of machine shop engaged in jobbing, repairing, or paper machine work. Address Box 304, Groton, Mass.

(*Continued on page 12.*)

HACKNEY HAMMERS

Meet all requirements more fully and satisfactorily than any other of its competitors.
INVESTIGATION IS NOT COSTLY.
INVESTIGATION IS CONVINCING.
WRITE FOR CATALOGUE TO
THE HACKNEY HAMMER CO.
20 Johnson St., CLEVELAND, O.



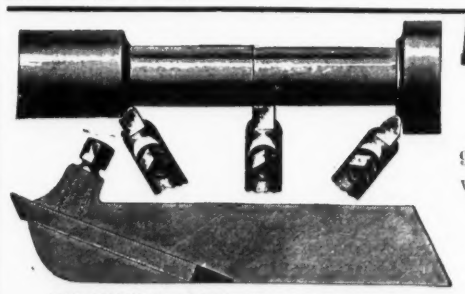
FOR SALE.
A Roney Mechanical Stoker.
In use only a short time.
MATTHIESSEN & HEGELER ZINC CO.,
La Salle, Illinois.

PATENT FOR SALE
OF A SIMPLE AND USEFUL
MACHINE TOOL
That has proved a great success in all other countries (Annual sales in Europe 500-600 machines.) Apply for particulars to W. L., care of American Machinist, New York.

VANDERBEEK'S

UNIVERSAL MILLING MACHINES.
FIVE STYLES: NEW PRINCIPLES.
THE STATES MACHINE CO.,
HARTFORD, CONN.

Bradley Hammers.
If you plate, draw, square, taper, swage, collar, spindle, or do any manner of die forging in iron or steel, a BRADLEY HAMMER will soon pay for itself, by what it will save over any other similar tool. Send for circulars.
BRADLEY & COMPANY, Syracuse, N. Y.

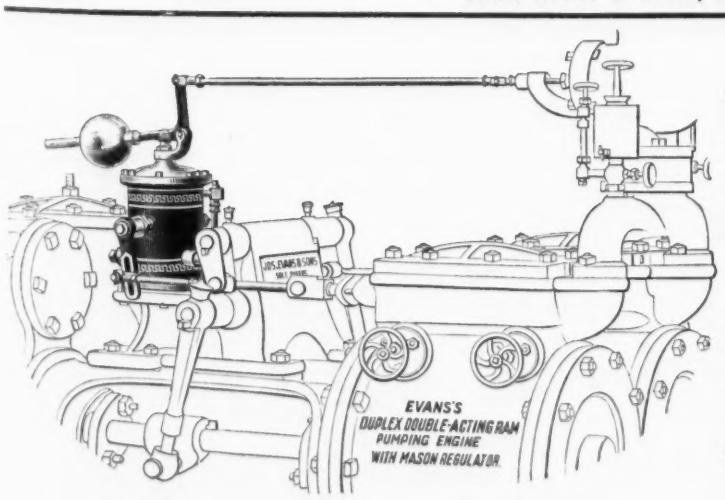


FOR GENERAL LATHE AND PLANER WORK.

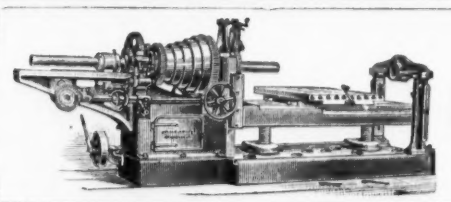
ARMSTRONG TOOL HOLDER.
A PRACTICAL SUBSTITUTE FOR FORGED TOOLS.
Saves blacksmith work. 70% grinding, 90% tool steel, and is a tool your machinist will take to.
Over 5,000 already in use.
Made in 5 sizes from ⅜" x ¼" to 1" x 1½"; other sizes in preparation.
SEND FOR CIRCULAR TO
ARMSTRONG BROS. TOOL CO.,
78 Edgewood Ave., CHICAGO, ILL.

Ready-made Gears.
Gears Made to Order.
Gear Cutting.
Gear Book, 15 Cents.
Geo. B. Grant,
Lexington, Mass.,
And 125 So. 11th St.,
Philadelphia, Pa.

THE GAS ENGINE,
History and Practical Working,
BY DUGALD CLERK.
With over 100 engravings. 12mo, cloth. $2.00.
JOHN WILEY & SONS, NEW YORK.



Method of Applying
THE MASON PUMP GOVERNOR
Manufactured by
MASON REGULATOR CO.,
BOSTON, MASS.



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WILMINGTON, DEL.
MACHINE TOOL BUILDERS.
IMPROVED PATTERNS! LATE DESIGNS!
Chicago Office: 14 South Canal St.

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ASBESTOS
ASBESTOS SECTIONAL PIPE COVERINGS.
Non-Conducting Coverings for Steam and Hot Water Pipes, Boilers, etc.
ASBESTOS BOILER COVERINGS.
H. W. JOHNS MANUFACTURING COMPANY,
H. W. Johns' Asbestos Millboard, Sheathings, Building Felts, Fire-Proof Paints, Liquid Paints, Asbestos Roofing, Etc.
87 MAIDEN LANE, N. Y. Jersey City, Chicago, Philadelphia, Boston, Atlanta, London.

✲WANTED✲

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Foreman Wanted—Who can rub men the right way to increase production and do good work. One familiar with high-grade engines desired H. G., P. O. Box 1001, N. Y.

Draftsman Wanted—To grow into responsible place in drafting room. Mod. price to start. Worcester tech. graduate preferred. Address, giving exp., and wages expected, Box 93, Am. Machinist

A mech. engineer of experience as supt., designing, estimating on work, management of men, etc. desires to invest a few thousand for partnership in a good concern. Address A., Am. Machinist.

Foreman in iron foundry, one familiar with all kinds of light and heavy machinery in green dry sand and loam; best of references from last employer. Address C., American Machinist.

Wanted—First-class Corliss engine general salesman of character and repute competent technically and practically to estimate on any power plant, and willing to live and travel anywhere west. Address, giving experience, reference and salary expected, T. E. G., American Machinist.

Wanted—One good man to erect machinery after built (outside man), and some good general machinists for shop work. Our specialties are coal mine haulage engines and mine ventilating fans; shop located in Pennsylvania. Address Box 200, American Machinist.

Wanted—Draftsmen and tool makers accustomed to jig and fixture work; permanent employment and good wages to men familiar with this line of work. Address Wardwell Sewing Machine Co., Woonsocket, R. I.

✢ MISCELLANEOUS WANTS ✢

Advertisements will be inserted under this head at 35 cents per line, each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Cheap 2d hd lathes & planers. S. M. York, Clev'd, O

Best Steel Flue Scrapers. Kelley Co., Erie, Pa.

Working drawings, etc. J. D. Riggs, Toledo, O.

For Sale—Second-hand drill presses, engine lathes and planers. Dietz, Gang & Co., Cincinnati, O.

Light and fine machinery to order; Foot Lathe Catalogue for stamp. E. O. Chase, Newark, N. J.

Best Bolt Header in the world for $50. Address C. H. Baush & Sons, Holyoke, Mass.

Wanted—Machinery and specialties to build. P. G. Fleming's Machine Works, Elizabeth, N. J.

Wanted—A Medart shaft straightener; must be in A1 cond'n; state cap'y. Address Shafts, Am. Mach.

For Sale—Half or whole interest in a well-established machine shop and foundry in a city in Western New York. Address Works, Am. Machinist.

Wanted—A fine set of standard size drawings for a modern type of Corliss engine. Address Box 82, American Machinist.

For Sale—Condenser beam engine, cylinder 36"x 7', air pump condenser, etc., complete, can be seen at Front and Pearl Sts., Brooklyn, N. Y., Brooklyn Brass and Copper Company.

FOR SALE.

The entire outfit of two well equipped Machine Shops, which we have just purchased. The lot comprises:

DRILL PRESSES,
ENGINE AND HAND LATHES,
PLANERS, SHAPERS,
PLAIN AND UNIVERSAL MILLERS,
CUTTER, SURFACE AND UNIVERSAL GRINDING MACHINES,
SCREW MACHINES,
TAPPING AND CENTERING MACHINES,
POWER PRESSES,
GEAR CUTTERS,
SQUARING SHEARS,
GRINDSTONES,
FORGES AND ANVILS.

All can be seen in our warerooms. Write for photographs, description and prices of tools wanted.

THE GARVIN MACHINE CO.,
Laight and Canal Streets. New York.

SECOND-HAND AND NEW MACHINERY

Planers.	54 in. x 24½ ft. 2 Heads.	Planers.	26 in. x 7 ft.
"	42 in. x 16 ft.	"	25 in. x 5 ft.
"	36 in. x 12 ft.	"	24 in. x 5 & 6 ft.
"	31 in. x 8 ft.	"	22 in. x 5 ft.
"	30 in. x 7 ft.	"	20 in. x 4 ft.

80 in. x 18 ft. Engine Lathe Geared Face Plate.
60 in. x 45 ft. Double Engine Lathe.
52 in. x 35 ft. Engine Lathe Horizontal Boring Machine, one end.
30 in. x 28 ft. Pond Machine Tool Co. Shafting Lathe.
36 in. x 16 ft. Engine Lathe.
33 in. x 27 ft. " "
32 in. x 12, 14, 16, 18 ft. Bed. New Engine Lathe.
28 in. x 22 ft. Engine Lathe, cheap.
25 in. x 12, 16, 20 and 24 ft. Bed. New do do
21 in. x 10, 12 ft. Bed. do do do
20 in. x 5, 6 & 8 ft. do 2d Hand do do
18 in. x 6, 7 & 8 ft. do New & do do do
17 in. x 8 ft. do do do do
16 in. x 6 & 8 ft. do do do do do
15 in. x 6 & 8 ft. do do do do do
14 in. x 6 ft. do do do do do
Car Axle Lathe, Bement. | Driving Wheel Lathe 88 in.
15, 16, 18, 25 in. Crank Shapers. | Wheel Quartering Mach.,
20, 24, 26 & 30 in. Geared Shapers. Double.
20, 22, 24, 28, 30 & 36 in Drills. | No. 0 Turret Lathe,
Bolt Cutters. | Am. Tool and Mach. Co.,
8 and 13 in. Stroke Slotters. | 24 in. Swing, 8 ft. Bed.
Lot of Lincoln Pattern Millers and No. 1 P. & W. Millers.
2 Spindle Drills. Garvin. No. 75 Bliss Press Geared.
O'Brien's Boiler Head Flanging Mach.; Gear Molding Mach.
1100 and 3000 lb. Bement Steam Hammer.
100 lb. Steam Hammer. | SEND FOR
40 H. P. Vert. Engine. N. Y. S. S. P. Co. | MARCH LIST.
11 in. x 18 in. Hor. Engine. A1 Order.
14 in. x 36 in., 16 in. x 42 in. Corliss and 16 in. x 48 in. Brown Eng.
300 H. P. Westinghouse Comp'd Engine.

GEO. PLACE MACHINE CO.,
120 BROADWAY, NEW YORK.

ENGINEERS

and gentlemen having business with Steam Users, wanted as agents to represent a prominent manufacturer. Write for circular and terms. Mention this paper.
Address **P. O. Box 137**, Philadelphia, Pa.

Experimental Work of every Description,

Mechanical and Electrical. Contractors for the manufacture of specialties, or can furnish complete plants for their manufacture. Make Dies, Special Tools, Gauges, Drawings, Patterns, Models. Inventions perfected. Estimates furnished. Correspondence solicited.

Send for Circular of our SENSITIVE KNEE DRILL.
BRADY M'F'G. CO. 83 Washington St., BROOKLYN, N. Y.

REMOVAL

MAY 1st to
14 DEY STREET.

We will close out at low prices previous to time of our removal the following

New and Second-Hand Machine Tools.

Engine Lathe, 43 in. swg., 10 ft. bed—Screw Feed, Cpd. Rest, and 43 in. Face plate. Price, $200.
Engine Lathe, 24 in. x 12 ft., Cpd. Rest and Cross Feed.
" " 22 in. x 10, 12, 14, ft. " new heavy pattern."
" " 20 in. x 8, 10 ft., Cpd. Rest and Cross Feed.
" " 18 in. x 8 ft., complete—Hol. Spin., Cross Feed.
" " 17 in. x 9 ft., " (Lathe & Morse). " $100
" " 16 in. x 7 ft., " (old style). " $50
" " 16 in. x 8 ft., " with Chuck, "modern." A1
" " 13 in. x 6 ft., Cpd. and Cross Feed, "new style."
Chucking Lathe, 22 in. x 7½ ft. with Rest and Bars. Price, $60
Planer, 24 in. x 5 ft., complete, full Auto. Feeds.
" 24 in. x 6 ft., " "new heavy pattern."
" 30 in. x 8 ft., " latest pat., ex. heavy. Good as new
Shaper, 6 in. stroke, 22 in. feed, complete. Good. Price, $80
" 9 in. " "Crank Motion," complete. Good order
" 13 in. " " " extra heavy. "
" 13 in. " trav. head with 60 in. feed, complete, with two tables and circular feed, ex. heavy. Good order
" 20 in. stroke, crank motion, extra heavy. A1 order
" 22 and 26 in. Triple Geared, "new style."
Drill, 13 in. wheel feed, (Putnam). Price, $35
" 20 in. " " new. " $55
" 32 in. back gears and auto. feed, complete.
Upright Boring and Turning Mill, 38 in., complete.
Gang Drills, 3 spindle, (Garvins). Good order. Price, $70
Slotting Machine, 8 in. stroke, modern style, complete. Good
Key-seating Machine, for pulleys and wheels, all sizes, new pattern.
Brown & Sharpe No. 5 Screw Machine, 1⅜ hole, with auto. Chuck and Chasing-bar. Good order
Brown & Sharpe Turret Chucking Machine. A1 order
Bolt Cutter, 1½ in. revo. die head. Price, $50
Bolt Cutter, for accurate thread cutting, 1½ in., with dies and taps.
Eberhardt Tool Grinder, wheel 14 in., and pump. Price, $60

J. J. McCABE,
SUCCESSOR TO
E. P. BULLARD'S N. Y. Mach'y Warerooms, **68 Cortlandt Street,** NEW YORK.

JESSOP'S STEEL

FOR TOOLS, DRILLS, DIES, &c.

ALL KINDS IN STOCK.
Manufactory, SHEFFIELD, ENG.
Chief Am. Office, 91 JOHN ST., N. Y.
WM. JESSOP & SONS, LD.
Established a century ago.

LATHES.

CHUCKS
REAMERS
DRILLS
SCREWS
BELTING
WASTE
EMERY
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LIST "J" ON APPLICATION.
FRASSE & CO.,
90-94 PARK ROW, NEW YORK CITY.

ELECTRICON.

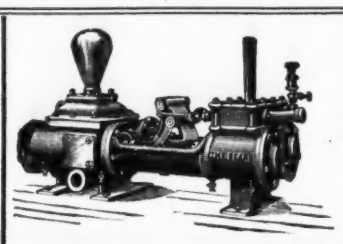
The Best Anti-Friction Metal in the World.

FOR ALL

MACHINE, RAILWAY AND MARINE BEARINGS.

HIGH QUALITY. LOW PRICE. SEND FOR SAMPLE.

UNION ELECTRIC COMPANY,
Manufacturers and Sole Agents, 45 BROADWAY, N. Y.



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OF HOLYOKE
STEAM PUMPS
DEANE STEAM PUMP CO.,
HOLYOKE, MASS.

CRESCENT STEEL CO.
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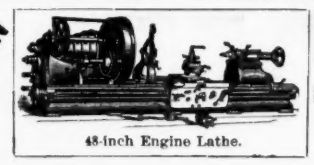
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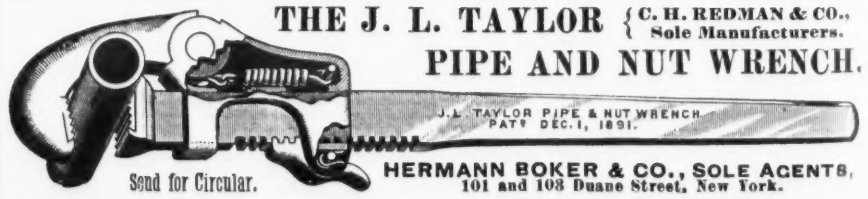

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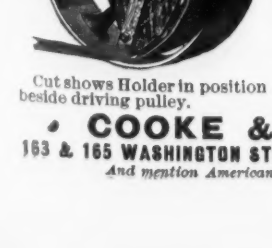

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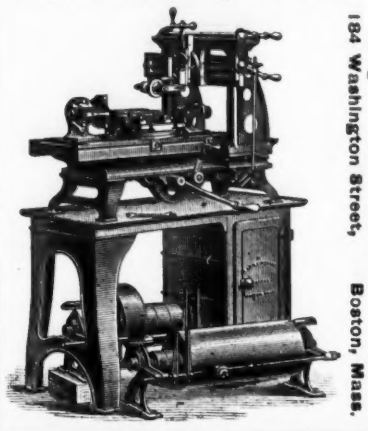

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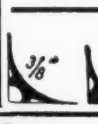

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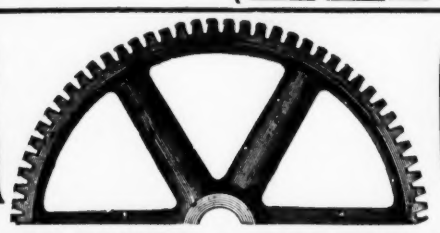

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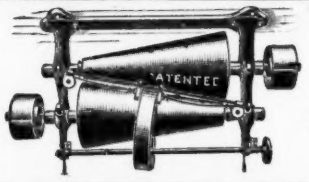

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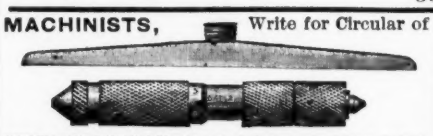

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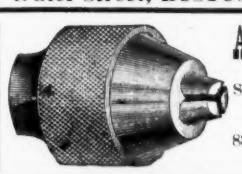

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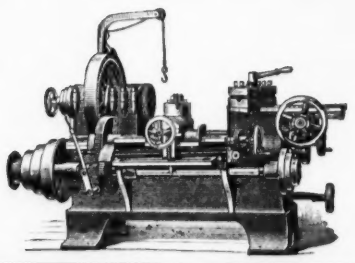

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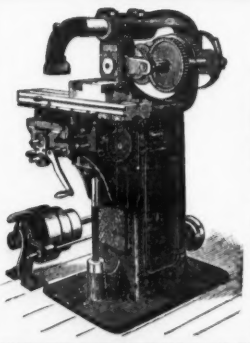

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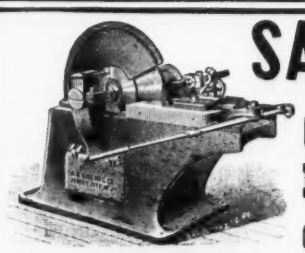

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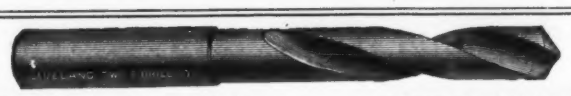

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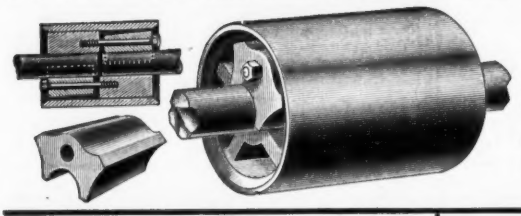

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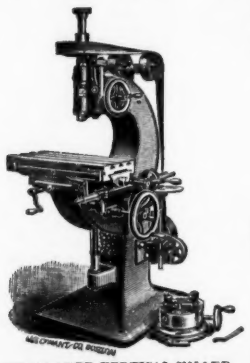

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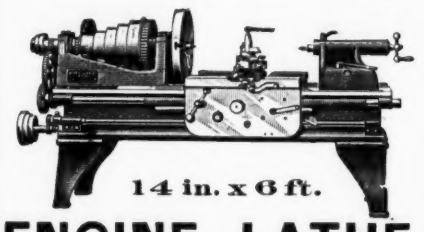

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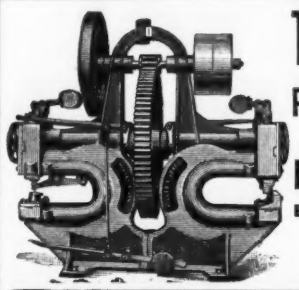

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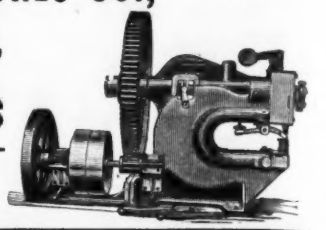

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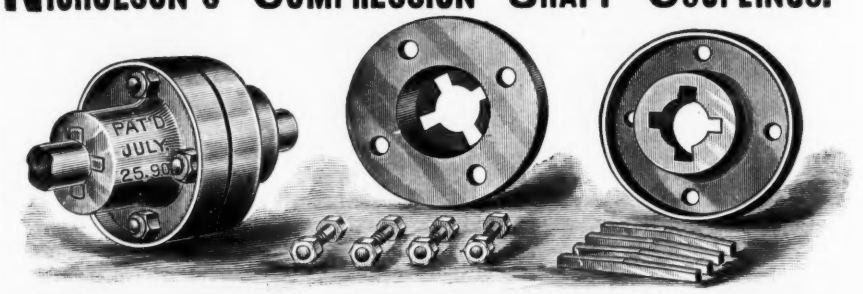

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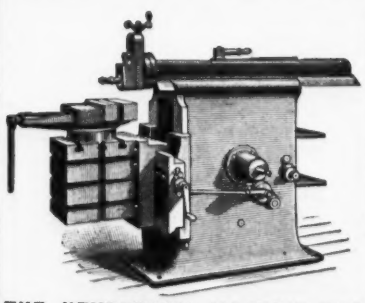

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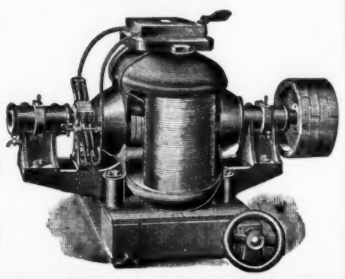

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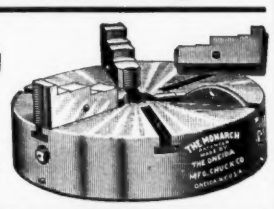

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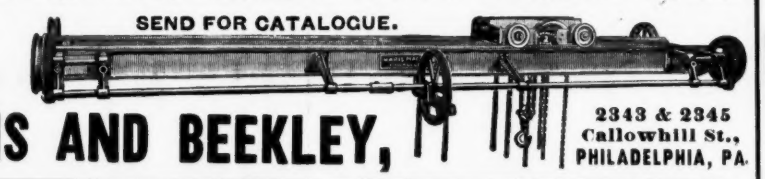

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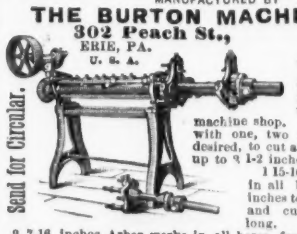

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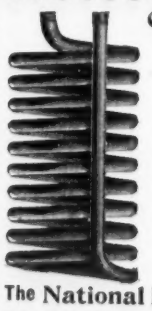

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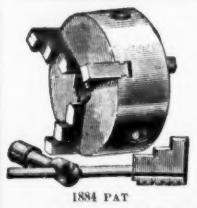

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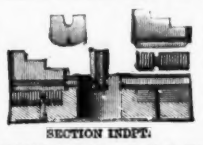

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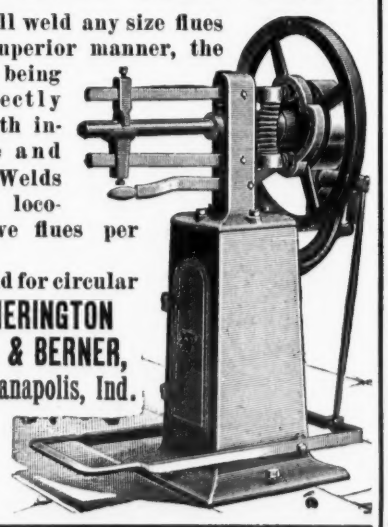

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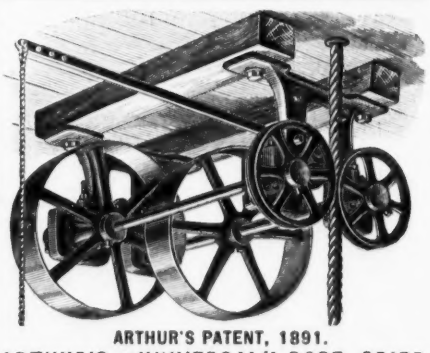

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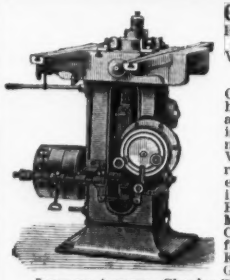

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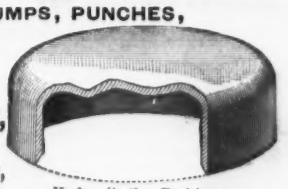

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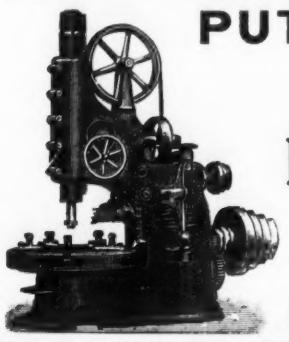

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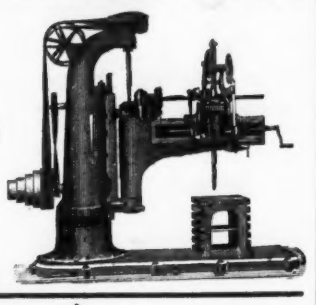

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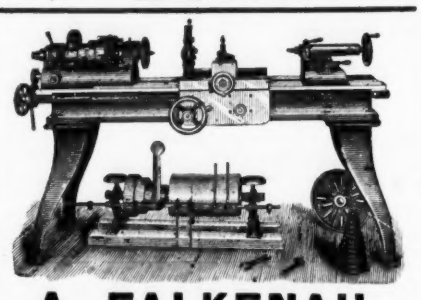

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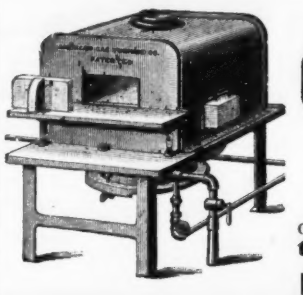

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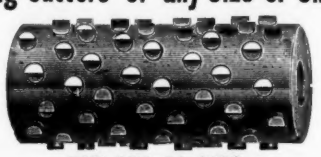

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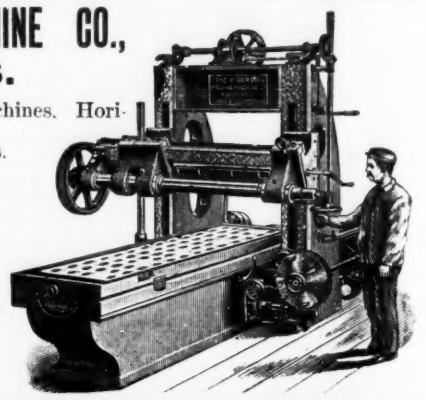

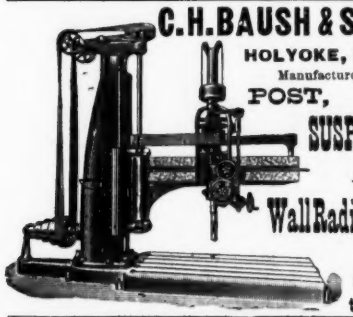

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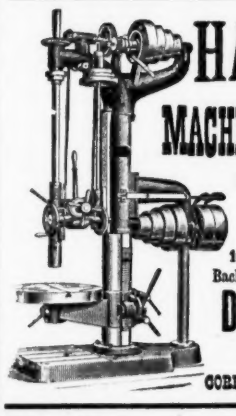

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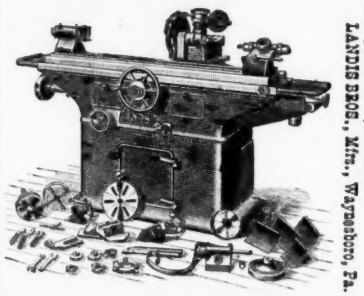

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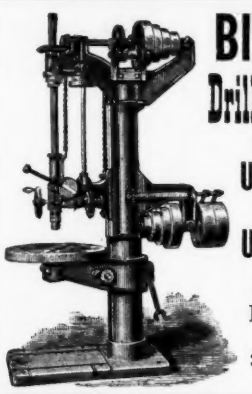

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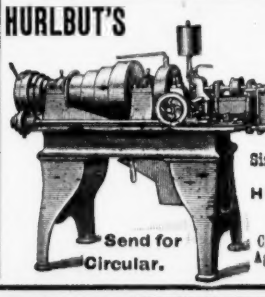

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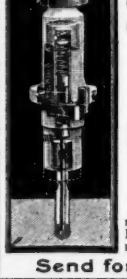

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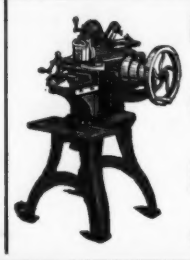

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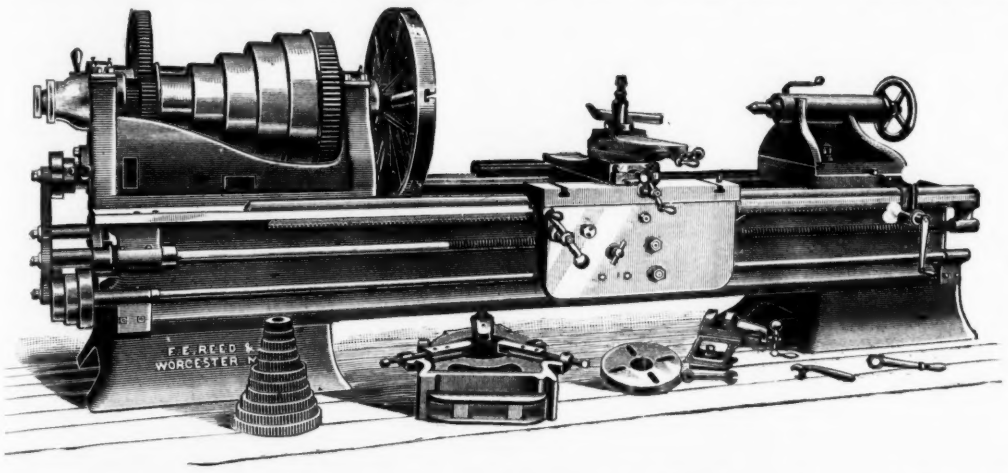

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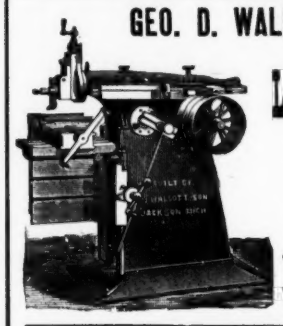

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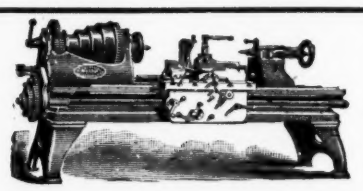

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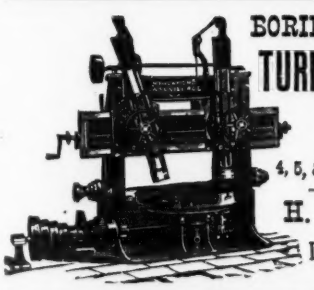

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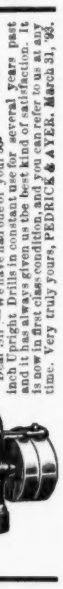

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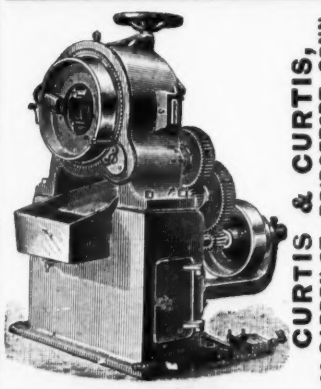

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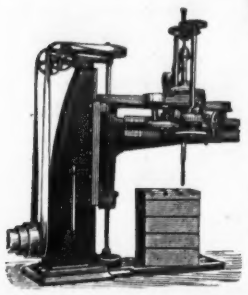

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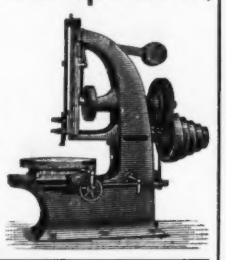

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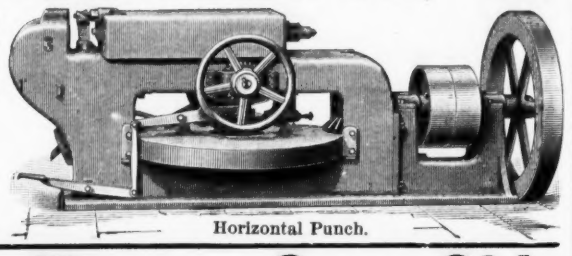
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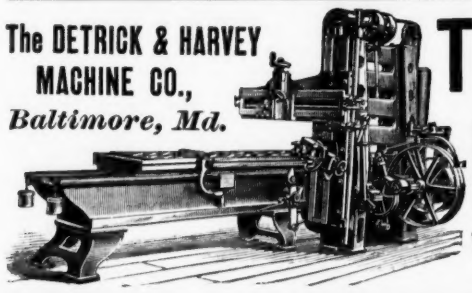

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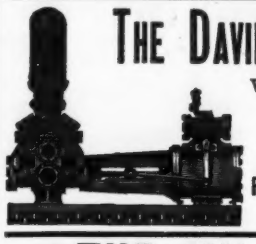

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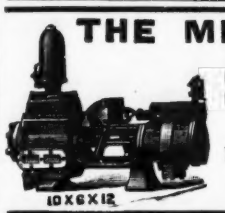
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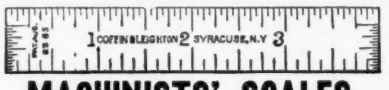

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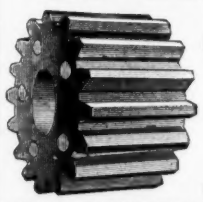

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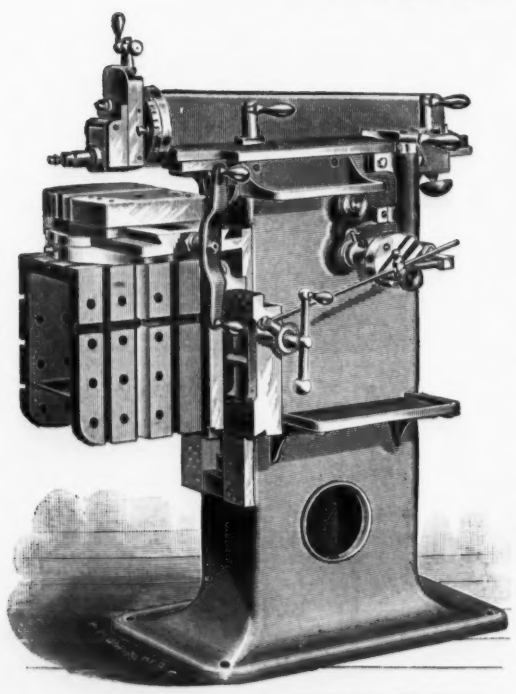
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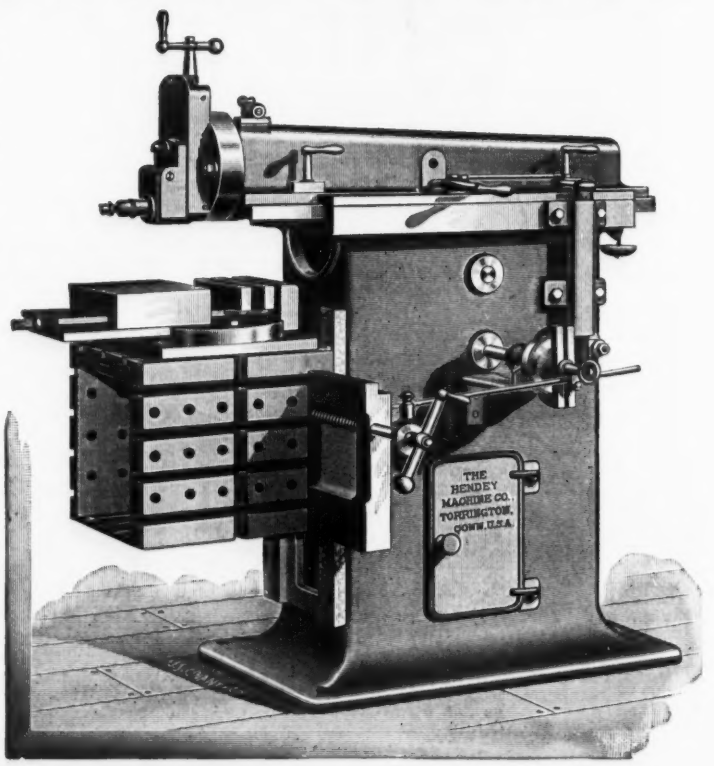

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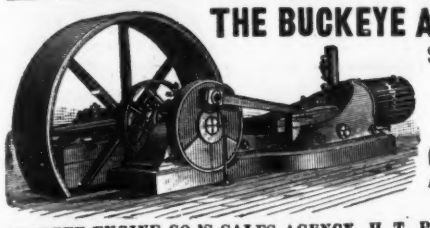

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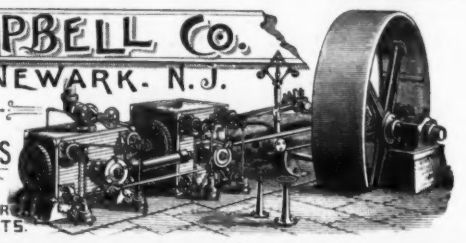

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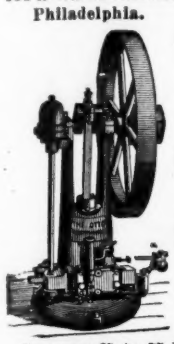

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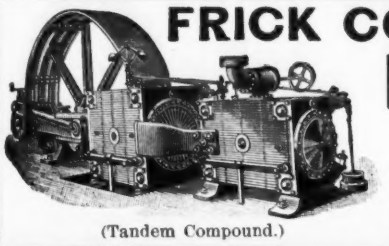

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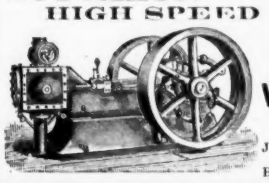

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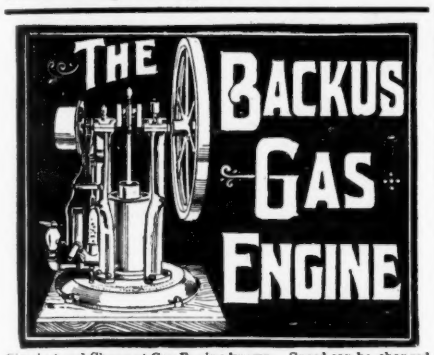

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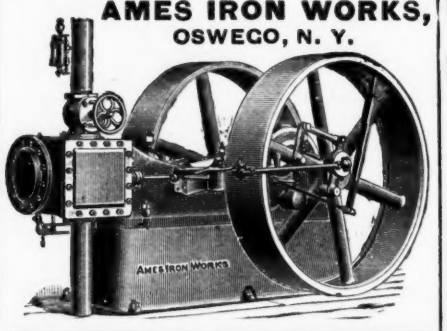

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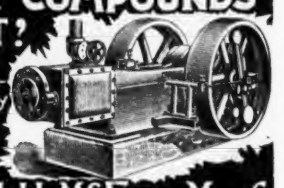

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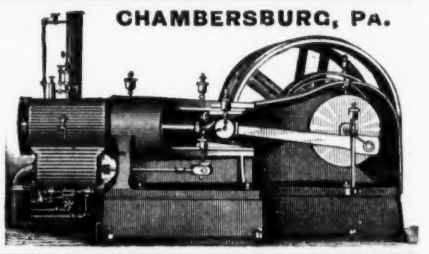

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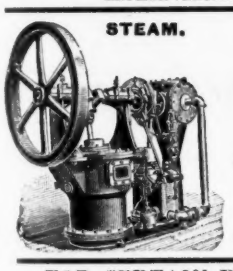

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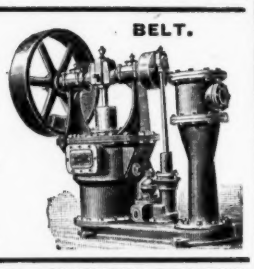

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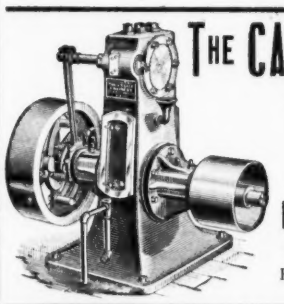

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512 ARCH ST. PHILADELPHIA PA. U.S.A.
ORIGINAL MANUFACTURERS OF PHOSPHOR-BRONZE IN THE UNITED STATES AND SOLE MAKERS OF "ELEPHANT BRAND" PHOSPHOR-BRONZE.

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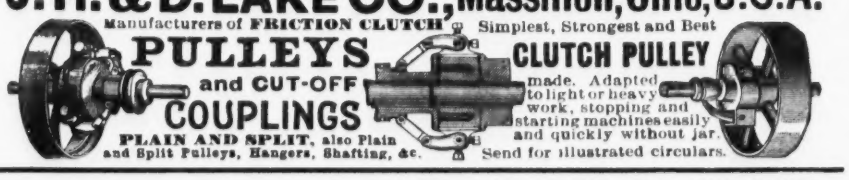
Manufacturers of FRICTION CLUTCH PULLEYS and CUT-OFF COUPLINGS

PLAIN AND SPLIT, also Plain and Split Pulleys, Hangers, Shafting, &c.



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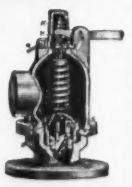
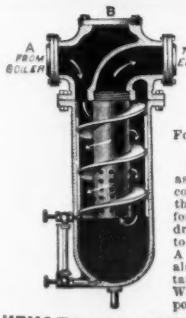


DRY STEAM.



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For Supplying Clean and Dry Steam to Engines, Dry Houses, etc.

Place Separator as close to engine as possible, the steam taking a spiral course between the threads causes the water to be thrown by centrifugal force against the outer walls, while the dry steam goes through the small holes to center of pipe. Steam can enter at A or B, as convenience may require; also used in conveying steam long distances, for Steam Hammers, Dry Houses, Water Gas Generators, and for all purposes where Dry Steam is necessary.

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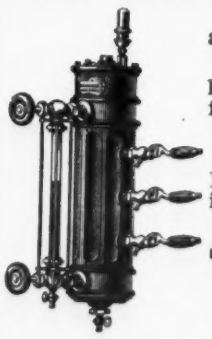

Protect your Boilers and your Lives.

Burn less coal, and have the satisfaction of feeling safe, by using

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It will prove a good investment.

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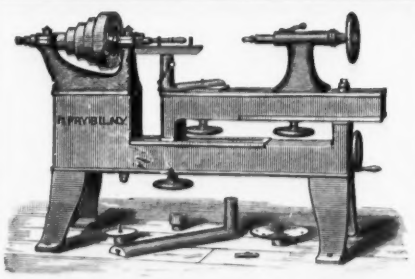
Agents wanted in every State.



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Made in Two Sizes.

22" Swing or 44" Extended. Weight 1,400 Lbs.
27' " or 60' " " 3,000 "

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Lathes of the Most Improved Styles and Latest Patterns.

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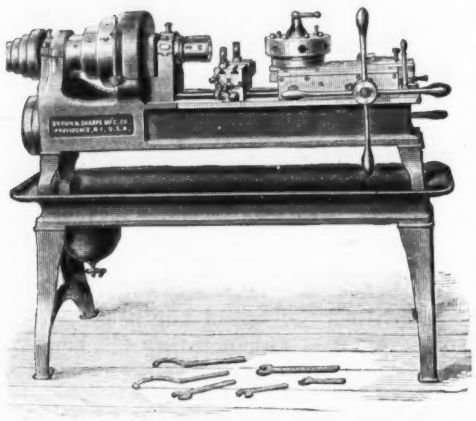

No. 6 SCREW MACHINE.

This machine is suitable for making studs, screws, and a large variety of small parts of machines, from the bar; also for finishing work held in a chuck when several tools are required, or a number of operations are to be performed.

Diameter of hole in spindle $1^{9}/_{16}$".
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Length that can be milled 6".

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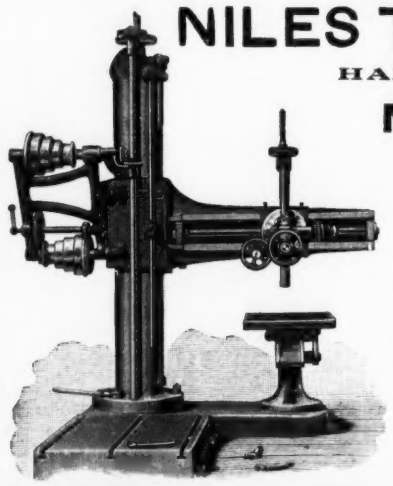

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Cutting from 1-8 in. to 6 in. diameter.
Also SEPARATE HEADS and DIES.
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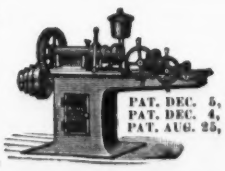

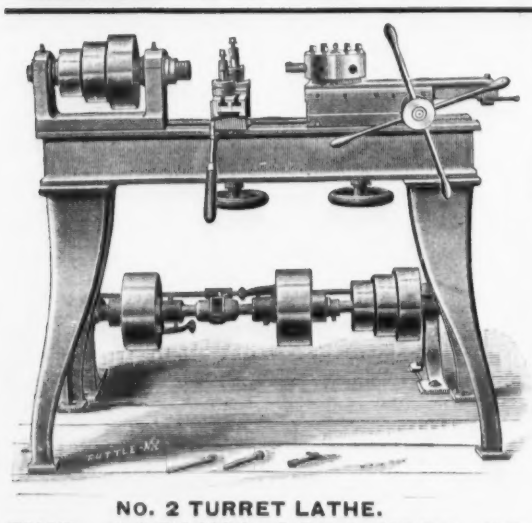

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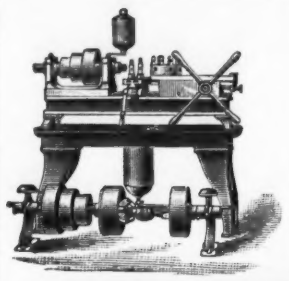

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Circular Milling Machines for finishing grooves of sheave pulleys, faces and sides of large gear blanks.

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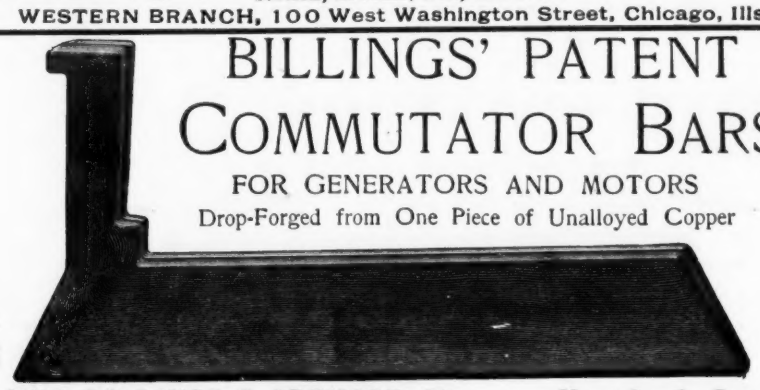

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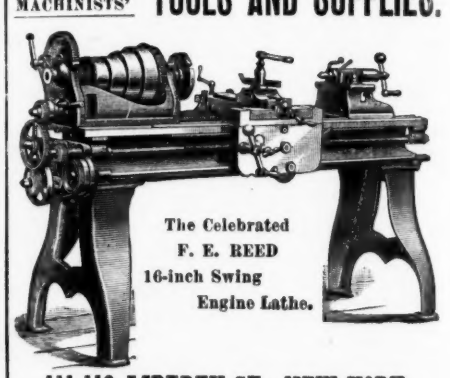

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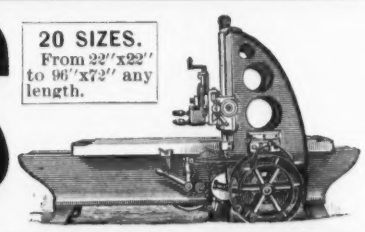

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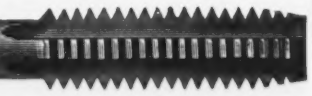

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